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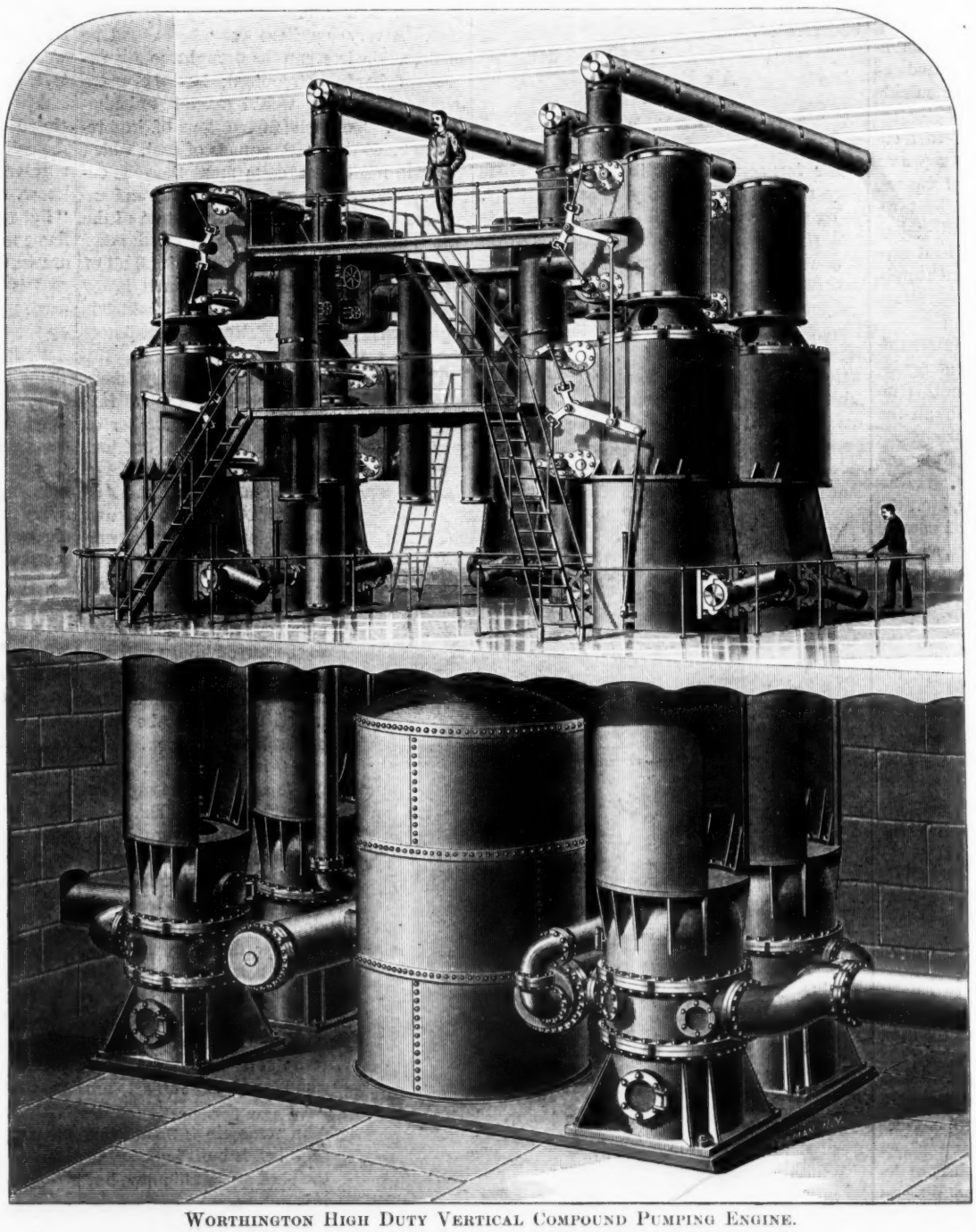
Worthington High Duty Vertical Compound Pumping Engine.

Our illustration shows a plant of three duplex compound direct-acting pumping engines, built by Henry R. Worthington, New York City, for The Artesian Water Co., Memphis, Tenn. Only two of the engines show clearly in the illustration, the view of the third one being partially obscured. Provision has been made for placing a fourth engine, should it ever be required by the growth of the city, in the space shown in the foreground, thus arranging them in the form of a square, with the main well in the center. The large cylinder in the center, made of boiler plate, is really a part of this well. It is not now covered over as shown, however, but is open at the top, the water, when the pumps are not working, rising nearly to this point, though the suction pipes extend to about fifty feet below it. Around this central well are a number of artesian wells, which are connected with it by tunnels.



WORTHINGTON HIGH DUTY VERTICAL COMPOUND PUMPING ENGINE.

The engines, each of which is of 10,000,000 gallons capacity, and works against a head of 250 feet, are, of course, essentially the same in principle as the horizontal engines built by the same firm, but are modified to suit the different conditions. The high-pressure cylinders are placed on top, and are 30″ diameter, the low-pressure cylinders being directly under them, and 60″ diameter. The pump plungers are 27″ diameter, and the stroke is 48″. The valves are of the Corliss type, with a cut-off valve placed over them, but are not, of course, worked by the Corliss valve motion, since the point of cut-off is fixed.

The compensating cylinders are, on these engines, placed on the frame between the steam and water ends, their plungers being connected directly to the main piston rods. For those of our readers not familiar with this class of machinery, it may be well to state that these compensating cylinders perform the office of a fly-wheel, and enable steam to be used expansively in a direct-acting pump, by storing up a certain proportion of the power at the beginning of each stroke, and giving it out again towards the end of the stroke, when the steam pressure in the cylinders has been reduced by expansion. Two cylinders are attached—one to each side of each frame just above the floor. They oscillate upon trunnions fixed near their inner ends, the point of connection between their pistons and the main piston rods moving an equal distance above and below these trunnions, so that at the beginning of a downward stroke of any plunger, the compensating cylinders attached to its piston rod will be inclined upwards; at mid-stroke they will be in a horizontal position, and at the end of the stroke inclined downwards. The outer ends of these cylinders are closed, and by an auxiliary air-compressor a pressure of air is maintained behind the plungers at all times. During the first part of the stroke this air is still further compressed, thus absorbing the surplus power due to the high initial pressure of steam. This compression goes on up to mid-stroke, after which the air commences to expand, and by its expansion gives out the power again. These engines are required to work at varying speeds, according to the amount of water called for; and one of the advantages gained by these compensating cylinders is that they are equally efficient at any speed, which cannot be said of the fly-wheel.

Below the compensating cylinders, and inside the frames, is a balancing device on each piston rod, which exactly balances the weight of the reciprocating parts. This consists simply of a cylinder through which the piston rod passes, and is provided with a piston to fit the cylinder, stuffing-boxes being provided at each end above and below. Below this piston is water, which, as the piston descends, is forced out of the cylinder through a pipe against a pressure of air, this air pressure forcing the water back into the cylinder again, and really lifting the weight of the reciprocating parts during the upstroke. The pressure of air for this is restored to the proper amount by means of the auxiliary compressor, when it becomes reduced through leakage.

Some of the advantages gained by this vertical form of engine are economy of space, and avoidance of friction and wear, by the weight of the reciprocating parts resting upon the bottom of the cylinder, but principally the fact that where the height of the water supply is liable to fluctuate, the pump cylinders can be placed low enough to insure easy and sure suction at the lowest stage of water, while the steam end may be at almost any desired height above, and entirely out of all danger of being submerged during high water. One engine of this type, built for use at the St. Clair Tunnel of the Grand Trunk Railway, in Canada, being 125 feet from foundation to the top.

Among the contracts recently awarded to this company is one for furnishing an engine of this type for Nashville, Tenn., which will be the largest direct-acting pumping engine ever built; these steam cylinders being 41″ and 82″ diameter, the pump plunger 26½″ diameter, and the stroke 60″. It is to pump 10,000,000 gallons against a head of 390 feet.

Experimental Engines.

Acting under the provisions of the will of the late Sir Joseph Whitworth, the eminent English gun and toolmaker, the trustees of the estate have made a gift of an engineering laboratory to Owens College, Manchester (Eng.) The laboratory contains a vertical testing machine, suitable for 224,000 pounds, and various other appliances; but probably the most interesting of all the appliances is a triple expansion engine, designed by Professor Osborne Reynolds, and constructed by Mather & Platt.

This engine is specially designed for experimental tests of a high order. The three cylinders are respectively 5″ diameter x 12″, 8″ diameter x 12″ and 12″ in diameter x 15″ stroke. Their relative capacities of piston sweep for equal rates of revolution are thus: 1, 2.56, 7.2. All the cylinders drive cranks on a continuous shaft. Continuity, however, is secured by means of couplings which are readily disconnected, so that during a test each cylinder can be run at a different speed, and the relative volume then varies accordingly. By this means the receiver pressures are capable of very fine adjustment. When running coupled the crank angles are equally capable of variation at the will of the operator. The cylinders are jacketed on both sides and ends, and a positive flow of steam is secured through them, or they may be disused, of course, as desired. The condenser is of the surface description. Hence the steam actually used in both jackets and cylinders is measurable, which is performed by actual weighing or measurement in a vessel of known capacity. The condensation water is measured by means of a tumbling bay, the discharge of which for several different heads has been determined by actual cubical measurement of the discharge in a known time; and during a test the head is maintained constant, as shown by the coincidence of a cross wire carried on standards with a fine line drawn across the vertical face of a tablet car-

ried by the float, proper provision being made for the elimination of all disturbing elements in the tank beyond the bay by suitable cross diaphragms.

Each cylinder carries a pair of Crosby (Boston, Mass.,) indicators, and thermometers are placed at all necessary points.

Though a driving drum is attached to each of the three crank-shafts, yet during tests the whole power of each cylinder is absorbed by a modified Froude's hydraulic brake, the design of Professor Reynolds, the resistance between certain curved cones in the casing, and similar but opposing cones of the fan revolving within being caused by the water which fills the case, and constantly flows through it. The outer case is prevented from revolving by being attached to a weighted lever, the weight on which, multiplied by its lever arm measured from the center of revolution and divided by $\frac{33,000}{2.\pi}$, is a constant quantity, which only requires to be multiplied by the number of revolutions per minute to show the brake horse-power. Hence, by means of counters attached to each engine, the revolutions in any length of time are known, and the horse-power is, of course, the above brake constant, multiplied by the total revolutions during the test. The brakes remain steady throughout a test, and each cylinder accommodates itself to its work; and its power is calculable most easily.

The cylinder or gross power of each engine is, of course, determined by repeated indicator cards; the brake power, of course, by the foregoing formula. The heat rejected is measurable at the tumbling bay and condenser discharge, and the heat supplied can be estimated from the feed supply to the boiler, and measurement of steam temperature and jacket discharge.

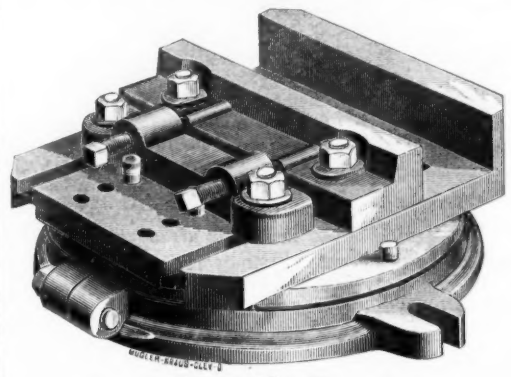
The whole of the heat converted into work at the brake is converted into heat again, which can be measured by the rise in temperature of the water passed through the brake casing. In every way the various calculations can be checked one against another, and from the tests can be found accurately the influence of the jackets, etc., the friction of the engines, excepting, of course, the piston friction, which is returned as heat *within* the cylinder, and therefore more or less utilizable as power again. By a careful equation of the heat rejected by the brake water, the condenser, the hot well and the jackets, with the heat accounted for by the feed water, on the assumption that all is converted into steam, there will be a difference in favor of the latter. This difference, of course, is the sum of the heat lost by radiation, and that due to part of the feed water leaving the boiler as water, *i.e.*, wanting the heat of evaporization. Thus, a careful determination of the coefficient of dryness of the steam can be made to give the loss by radiation from the cylinder's brake casing, friction of bearings, etc. As almost every variety of arrangement is possible between these three engines, both in steam pressure and cylinder capacity, as well as in jacketing, the value of this gift to the college cannot be overrated as an aid to the acquisition of an accurate scientific knowledge of the action of steam in an engine by the students of the college, which must stand them in good stead when called on to design engines for actual work.

The crosshead slides of this engine are designed so as not to have heat-conducting connection with the cylinders, thus keeping cool and in good order. The engines are of the vertical type, with slide valves fitted with cut-off back slides of the Meyer type to each cylinder, variable by a hand-wheel, and so affording every possibility of pressure adjustment between cylinders in the receivers, which also are jacketed.

The tests being carried out by students, there is no lack of observers for every little detail of water measurement, thermometric reading or card computation. The indicator rig is simple, and the cord connection as short as possible to avoid lost motion by elasticity. It is hoped that, with such unsurpassed facilities for correct determination, something valuable will be published bearing upon the results of various possible ratios of speeds, pressures and temperatures.

Planer Chuck.

The Brightman Machine Co. (Cleveland, Ohio,) have placed upon the market an improved planer chuck, of which we give an illustration on this page. It has a circular base which bolts to the planer bed, and upon this base is mounted the upper plate, which turns to any desired angle, the two being connected together by a taper pin shown, which fits into holes in the base just 90° apart, so that the jaws of the chuck can readily be set parallel with the motion of the planer bed, or at right angles to it. A movable cross-piece is provided, carrying the set screws for setting up the movable jaw. This cross-piece, in addition to the bolts for clamping it in position, is prevented from slipping by the two pins shown behind it, which can be inserted in holes provided for the purpose in the bottom of the chuck, and thus no blocking is required to follow up the movable jaw when holding small work. They are made in two sizes, with lengths of jaw of 10″ and 14″, and opening 6″ and 9″, and in special cases the jaw opening can be increased.



Planer Chuck.

Air Furnaces.

By Robert E. Masters.

Air furnaces are used in foundries where they make extraordinarily heavy castings, using a reservoir to hold the iron after it is melted; and in malleable iron foundries, where the iron runs from the spout and is caught in hand ladles.

Concerning this latter class of work, Mr. Frank S. Taggart, superintendent of the Missouri Malleable Iron Co., St. Louis, Mo., writes: "If anything I can say will be of advantage to the American Machinist readers I will be very glad. We make the bottom of the furnace of fire sand, and then close the furnace, and fire it for about an hour with the natural draft of same; this is to dry the bottom. The blast is then put on and fired again for another hour, for the purpose of melting the bottom; this makes it hard, so that when the iron is thrown into the furnace it will not imbed itself in same. The furnace is now hot, and the iron is charged through an opening in the top of furnace, which is then closed by a bung, and the furnace again fired with the blast.

"A heat of five tons will take from three to four hours to melt, and be ready to draw. Our heats average this amount at present, and we take off three heats every other day from one furnace. The fuel used is the best quality of Pittsburgh soft coal, the same as is used in the manufacture of illuminating gas.

"We tap the iron from furnace the same as from the cupola, and carry it off in hand-ladles. We aim to draw off the heat as quickly as possible, which usually takes from twenty to thirty minutes. We do not use the air furnace for grey iron; it burns out the carbon in the iron, which causes it to become hard, and unfit for light castings. It could be used in making very heavy castings. A very excellent car wheel could be made, as the iron can be brought to any degree of hardness required, but the extra expense in melting would cause it to be impractical. To melt fifteen tons of iron requires 9,000 to 10,000 pounds of coal, which you will readily see costs more than the cupola. The advantages of the air furnace are a thorough mixture, even temperature of the metal, and being able to skim off the slag and foreign substances from the iron, all of which cause it to anneal at a much lower heat than iron melted in the cupola, which is a great saving, and partially counterbalances the extra cost of melting."

The furnace shown is in a foundry where a great deal of work requiring a blast furnace has been carried on for a number of years past. Fig. 1 is a longitudinal section. Fig. 2 is an elevation of same. The right of Fig. 3 is a cross-section of one-half the furnace through *A* to *A*, and the left is a cross-section from *B* to *B*. This furnace works with a natural draft alone, and where this is the case the chimney is built high enough so the surroundings will not obstruct a free draft. And it is absolutely essential that it and the furnace be built on a solid foundation.

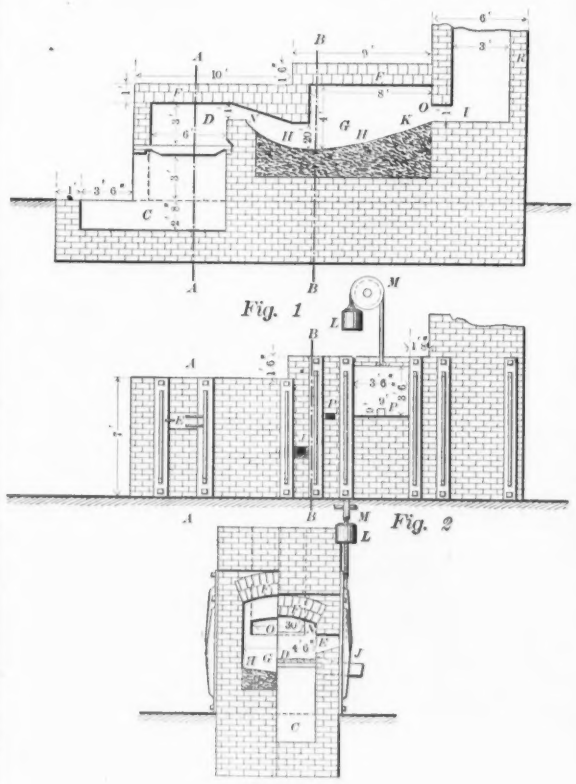


Fig. 1

Fig. 2

Fig. 3

Air Furnaces.

C C is the ash pit. *D* is the furnace for fuel supplied through door *E*. The walls *F F* are arched over the furnace and charging room *G G*. The bottom of the sand bed *H* can be made up of cinder and sand, and the upper portion made the same as the bottom in a cupola. A paddle made for the purpose can be used to rap down the surface of the bed firm and smooth, but it should not be rapped too hard.

In some air furnaces this sand bed is built tapering to the back of the chimney, but it is not a good plan, as the draft is so strong at *I* that it cuts the bed, unless it has been made with extra care. It is not necessary to build a new bed every time if the furnace works well; the bed will become glazed over and will last for a number of heats with a little daubing wherever it is required. The bottom of the stack, and the whole inside of the furnace, should be lined with first-class fire brick.

The spout *J* is located at the lowest point, with the bed sloping gradually towards it from all directions. By cutting the bed down at *K* the furnace could be made to hold a great deal more iron if needed, and yet have the spout at the lowest point. The spout can be located according to the position of the furnace; I know of several furnaces that are built in the wall of the shop, making in itself part of the wall, the furnace extending outside; in this case the spout is inside of the foundry, on the opposite side to the charging door. The charging door shown is 3′ 6″ square, and is lined with fire-brick; it has a counterbalance weight *L* connected with a wire cable over sheave *M*.

When filling the charging room with iron, on a new bed, the bottom is covered over with pieces of culled boards, and small, light scrap laid over these; then the heavy pieces, which are swung with a crane into the door, can be rolled and distributed around without cutting up the bed; small iron can be filled in between the large pieces, so that it is not made too solid to obstruct the draft; and it is a good plan to build a barricade of iron inside the charging room around and about 18″ to 20″ away from the spout, so that space will be clear; the first iron that becomes fluid settles next the spout, and chunks of dead iron lying there have a tendency to chill it; and to straighten up a chilled-up furnace is usually worth more than the heat would have come to.

After the furnace is charged, the door is closed down and sealed up, to shut out all the cold air possible. The furnace is fired at regular intervals with soft coal; some, I know, use pitch pine, commonly called "light wood" in the South, on account of the flame to be obtained from it. The flame is drawn through the iron from *N* to *O*. When coal is the fuel, a flat chisel-pointed bar is used, to keep the grate bars free, and loosen up the coals.

P P are puddling holes; they are for watching and testing the iron. These are sometimes closed with a cast-iron box or case filled with fire-brick and clay, having a wrought-iron loop in the back of them, so they can be handled quickly; but oftener the hole is filled with fire-brick and daubed over; the quickest method of opening and closing and sealing them up to do the work required is the best, as less cold air gets in. If any of the chunks of iron are not melted, they can be broken with a bar through these holes, and stirred up in the "bath." To try the texture of the iron, a small hand-ladle, daubed inside and out, is put through this hole, and a test piece cast and broken. By melting the iron down hot in the start it can be held by keeping up the fire until it acquires the requisite hardness; for this reason there are many foundry men, as well as rolling mill men, who think to this day that a roll cannot be properly made unless it is cast from an air furnace.

Some foundries have a double air furnace, that is, there are two similar to Fig. 1 connected to the same chimney; in this case the chimney would be about twice as large as the one shown, and *R* would be a bridge wall in the center of and extending about 6′ up into the chimney; above this the opening would be one, the furnaces would be fired at opposite ends, and the spout of each furnace would be connected with troughs or runners to a reservoir.

A citizen of Elma, Cal., has finished working up a fir tree which grew on his place. He received $12 for the bark, built a frame house 14x20 feet, 8 feet high, with a kitchen 8 feet wide and 20 feet long; built a woodshed 14x30 feet; made 330 fence rails 10 feet long; made 334 railroad ties, 500 boards 6 inches wide and 2 feet long, and 15 cords of wood. All this from one tree, and a part of the tree is left.

This is the time of year when every one looks to the farmer. The crop prospects shape the probability of future business. Just now the tiller of the soil is at the front. Fortunately there is every probability of excellent crops, and this goes a long way in assuring good business.

Care of a Micrometer Caliper—Opinion.

By Jarno.

Within a few years I have noticed in the market micrometer calipers that are arranged to indicate measurements in units of the ten-thousandth part of an inch. A caliper that will correctly indicate its measurements to within one ten-thousandth part of an inch is truely wonderful. It is of this special micrometer that I would speak. So fine a tool needs special care.

First let us try to form some conception of how small the unit of this caliper is. Perhaps we can do this, but to have any direct perception of the ten-thousandth part of an inch, is, I think, well-nigh impossible. A single sheet of the paper upon which the American Machinist is printed is something more than thirty-two ten thousandths of an inch in thickness. We can see that the sheet has thickness by looking at its edge. If a fine black line were drawn in the middle of the edge, perhaps we could see the two parts in which it would be divided; but we could hardly tell if it were divided into four parts, and if it were divided into thirty-two parts, they would, in our perception, have no meaning whatever. Again, an average-sized hair is twenty-five ten-thousandths inch in diameter. If a hair were fluted by cutting seventy-five grooves around it, they would mean nothing so far as we could perceive. Machinists are familiar with the fact that, under favorable conditions, light can be seen through a space of about one four-thousandth of an inch; the conditions being that the approaching surfaces be bright, and not broad. Yet I do not think that the space is actually seen as a space, but only the beam of light that passes through and is enlarged before it reaches the eye.

Hence, it would appear that, to make the caliper's unit mean anything except in conception, we must have some device that magnifies. A common way of magnifying is with a screw, or with a microscope. In a micrometer caliper, it is the screw.

Let us consider how delicate a thing this screw is. Some years ago I spent several hours in the mechanical laboratory or workshop of Lewis M. Rutherford. I there learned an interesting thing, that may well be remembered in the use of a micrometer caliper. Mr. Rutherford had a ruling machine for making fine lines, often more than ten thousand to an inch. These lines are generally made upon speculum metal or nickel, and sometimes upon glass. A piece thus ruled is called a grating. A grating is used for diffracting or breaking apart light. When a beam of sunlight falls upon a grating, it is broken apart or decomposed into various kinds of light of different colors, those of the rainbow being the most prominent. Machinists sometimes see these colors when looking along the surface of a piece of brass that has just been planed. Now, if a grating is not evenly ruled, there is an irregularity in the colors that is fatal to its use for scientific purposes. In the machine there is a leading screw, upon the accuracy of which depends that of the grating. When the machine was first finished it did excellent work. After a time, Mr. Rutherford was surprised and perplexed by learning that the machine no longer ruled perfect gratings. Upon examination, he found that the screw had been ruined in consequence of having been used more in one part than in another. He made a new screw, and ever after, when he turned it at all, he turned it enough to move the nut from one end to the other, in order that the screw be worn equally in all parts.

Hence we conclude that, in order to keep a micrometer caliper accurate, the screw must be moved the whole length when moved at all. It is not considered a good practice to grasp the screw and whirl the body around when opening or closing the caliper. Some workmen prefer to hold the caliper by a wooden clamp handle, as heat from the hand may change the caliper so that exact measurements cannot be made.

In the use of this caliper there are things that may mislead. A man may vary—the caliper may vary. The variation in one may offset that in the other, and a correct result be obtained; both variations may be in the same direction, and the result be doubly incorrect. This uncertainty is often confusing. Twelve years ago, Prof. Alfred M. Meyer asserted that we cannot rely upon the measures of a screw to a quantity less than the one five-thousandth of an inch. I cannot but think that he is right. Certainly there is no one measurement that can be relied upon; we must take the average of several. I once knew of a man that was shop umpire in cases in which questions of sizes were to be decided. He made the attempt to keep within the limit of a ten-thousandth inch. Then his troubles began. A piece that was right at one time might at another be either too large or too small. Sometimes he would be measuring continuously for hours, after which he was wholly unfitted for doing anything but to attempt to arrange his thoughts, for he was on the verge where the real becomes indefinite and confused, where one set of sensations do not agree with another, and any attempt to unravel leads only to more confusion, and finally to utter weariness, that brings the fear of approaching loss of powers.

Fig. 1

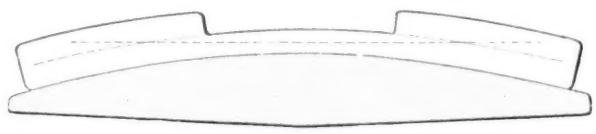


Fig. 2

Fig. 3

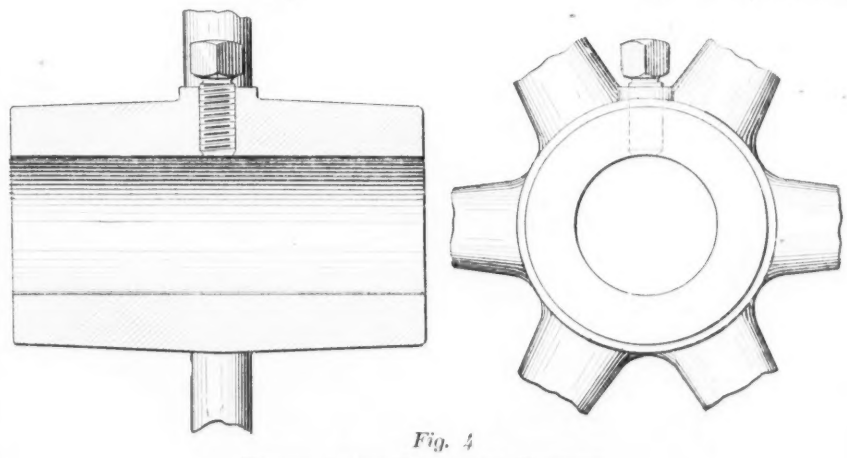


Fig. 4

Points About Belts and Pulleys.

This caliper is generally bought to lay away, with the idea that it may be wanted once or twice in a lifetime. This may be well enough; it may yield a little of that enjoyment that some have in owning a rare old book, which is treasured, but not read. No doubt the tool is well made, certainly as well as the price asked for it will admit. The name of the maker—a name high in the world of mechanics—is an assurance that every practical effort has been made to produce a good tool. A caliper should be tested in several places; it may be right for some sizes and not for others. It is well known that the difference of a ten-thousandth inch between the sizes of two pieces is easily detected; but this does not cover the thing at which the caliper is aimed. The real problem is to determine the actual size of a piece in parts of an inch, without reference to the size of any other piece whatever. Taken all in all, the ten-thousandth inch micrometer caliper causes more misunderstandings, disputes and trouble than all the help it ever gives. Among workmen it is a disturbing element. The attempt to work to a limit of a ten-thousandth inch is a delusion and a snare. Whoever says that he works to this limit is either deceived or is trying to deceive, for the groping about over things too small for our perception is as hopeless as an attempt to comprehend the infinite.

Some Points About Belts and Pulleys.

By Fred J. Miller.

Leather belting is sometimes made in this country, which is of single thickness in the center and double at the edges, or, in some cases, double in the center and triple thickness at the edges. Such a belt is said to have riders upon it, and is made by the belt manufacturers upon orders only, the philosophy of so making it being generally supposed to be, simply, that it strengthens the belt at what is usually its weakest part, that it makes it conform more readily to the surface of a pulley which is considerably crowned, and that, for some reason not perhaps thoroughly understood, as good results are often obtained from such a belt as can be obtained from a double or triple belt at less expense, and with less weight upon the journals. Prof. Sweet saw some such belts running on the other side of the water recently, and noticed that they ran unusually well, and also that the pulleys over which they ran were made with faces more crowned than is usual. This, of course, led him to thinking upon the subject. Pulleys made with considerable crown conduce to steady and generally satisfactorily running belts; but there is an objection to excessive crowning because of the slipping induced by it, the outer edges of the pulley, owing to its smaller diameter there, having a tendency to revolve faster than the central portion. It is, of course, well understood that, as a belt passes over a pulley, it conforms to the circle by being stretched at its outer surface, and compressed, or crowded together, on its inner surface. Between the two surfaces there is a point which is neither stretched nor compressed, but retains its normal length. It is this point which controls the actual angular velocity of the driven pulley, and its distance from the surface of the pulley depends somewhat upon the kind of belt used, which side runs next the pulley, and the tension or strain put upon the belt. In making calculations for speed it is usual to assume this point at half the thickness of the belt, adding the total thickness of the belt to the diameter of each pulley. Seeing these belts running so nicely at Paris, Prof. Sweet conceived the idea that it was possible to so proportion the thickness of a belt at the sides, by means of riders, with reference to the crown of the pulleys, as to make this circumstance of the neutral point in the belt counteract the evil effects of the crown of the pulley.

In Fig. 1 a section of such a belt is shown, and also a section of a flat pulley rim, upon which the belt is supposed to be running. If this belt were of uniform thickness there would be no slip upon its surface, but since the neutral line (indicated by dotted lines) is nearer the center of the shaft at the middle of the face of the pulley than at the sides, the tendency is to drive the middle portion of the pulley fastest, and the result is slip, with waste of power and wear of the belt.

In Fig. 2 the same belt is shown on a pulley, the face of which is crowned sufficiently to bring the neutral line at an equal distance from the center of the shaft at three points, which are in the centers of the three divisions of the belt. It is obvious that, though this pulley is crowned much more than is usual, the slippage will be reduced to a very small amount, which will be divided up between the points indicated, and the best practical results ought to follow, so far as smooth and satisfactory running are concerned.

When making the sketch for Fig. 2, it naturally occurred to me that the theoretically perfect belt, so far as this matter of slippage is concerned, would be one in which the neutral line was at a uniform distance from the center at all points, instead of at three points only. And such a belt is shown in Fig. 3, the dotted line, representing the neutral line, being parallel with the center line of the shaft. This requires that the belt be thinnest in the middle, and gradually increasing in thickness toward each side, the difference between the thickness at the center and at the sides being equal to twice the crown of the pulley; of course, assuming the neutral point to be at the middle of the thickness of the belt.

I did not suppose that it would be commercially practicable to make a solid leather belt in that way, and the superintendent of a belt factory, with whom I talked these matters over, said that it would not be. But I presume the obstacles to the making of a belt of that section would not be so great in the case of some other materials, such as rubber or canvas, and it might easily be done in the case of leather link belts.

At any rate, so far as neutralizing the evil effects of crowning pulleys is concerned, this form would seem likely to be the ideal toward which practice should tend.

When speaking of this matter of belts and pulleys, Prof. Sweet mentioned the common practice of putting set screws in the hubs of pulleys, one on each side of the arms. He believed a better practice in every respect would be to put them in the center of the hub between the arms, as shown by Fig. 4. A set screw so placed has no tendency to make the pulley wobble when tightened, it is easy of access with a wrench from either side, and is not nearly so liable to catch a belt or the clothing of workmen. It often happens that pulleys are placed so close together upon a line shaft that only one side of a pulley is accessible, and every machinist knows that it is a very difficult matter to get a wrench through between the arms of a pulley and tighten up a set screw on the other side. Placed as shown in the sketch, the screw is easily accessible from either side, and when it is desired to put in more than one, they can be put in contiguous spaces, or, in other words, one in front of and the other behind a given arm, which, besides the other advantages mentioned, is a better disposition of them, so far as mere holding of the pulley is concerned, than putting them in line with each other, one near each end of the hub.

Spokane Falls was a flourishing village in Washington Territory. But a ten million dollar fire has reduced it to ashes. The principal reason for such an extensive conflagration was the lack of adequate fire protection. It is a case likely to be repeated in the instance of a hundred flourishing villages in the country. Ten million dollars would pay for perpetual fire protection for a large town. There is a moral in the Spokane Falls disaster. It is not necessary to point it out.

The half year's production of steel ingots was greater by 36,127 net tons than during the first six months of 1888. The production of steel rails this year was only about 50,000 tons less than last year, or 719,572 net tons, of which 546,675 tons have been shipped from the mills.

Practical Drawing.

BY J. G. A. MEYER.

EIGHTY-THIRD PAPER.

605. Figs. 496*a*, 497*a*, 498*a* represent the vertical projections or elevations of one and the same pyramid ; but in each figure the cutting plane passed through the pyramid has a different direction ; it is required to find the sections made by these planes.

These sections can be found by methods similar to those adopted for finding the sections made by planes passed through pyramids, as given in previous problems. No new principles will here be introduced, and the student should not have any difficulty in finding these sections without any further instructions. But sometimes these methods can be shortened, and our purpose in giving these problems is, besides impressing on the student's mind the principles previously given, to indicate how labor may be saved, and how the position of straight lines in the different views of an object can sometimes be found with comparatively little trouble. For instance, according to Art. 245 we may conclude that we must find at least the projections of two points of a given line before the projection of the given line can be drawn; and this is true so long as we deal with lines only, without any reference to the outline of which they form a part. But often the outlines of a solid or a piece of mechanism, whether this solid be a pyramid or not, will indicate the direction of some particular line we wish to draw; in such cases we need to find the projection of only one point of this particular line, and the projection of this line can then be drawn. This way of finding the projection of a line is of practical importance, as it may often save us considerable labor.

606. Let $v\ a\ c$, Fig. 496*a*, be the vertical, and $v_2\ a_2\ b_2\ c_2\ d_2$, Fig. 496, the horizontal projection of a right pyramid with a square base, two of its lateral edges being parallel to the vertical plane of projection ; let $e_2\ e_4$ be the given cutting plane, which is also parallel to the vertical plane of projection. Under these conditions the axis of the pyramid will be parallel to the given cutting plane; in fact, all these conditions are plainly shown in the figures, and should readily be perceived by the student if he has made himself familiar with former problems and definitions. It is now required to find the vertical projection of the section made by the given cutting plane.

Here we simply draw vertical lines through the points e_4 and e_2, cutting the base $a\ c$ (Fig. 496*a*) in the points e_5 and e_3. Through e_5 draw a line $e_5 f$ parallel to $v\ a$, and through e_3 draw a line $e_3 f$ parallel to $v\ c$, meeting $e_5 f$ in the point f. The triangle $f\ e_5\ e_3$ will be the vertical projection of the required section.

Now let us consider whether or not we are justified in finding the section in this manner.

The line $v\ a$ in Fig. 496*a*, and the line $v_2\ a_2$ in Fig. 496, are the projections of one and the same edge of the pyramid. The line $e_4\ f_2$ represents the intersection made by the cutting plane with the lateral face $v_2\ a_2\ b_2$. Now, since the lines $v_2\ a_2$ and $e_4 f_2$ lie in the same lateral face, $v_2\ a_2\ b_2$, or, we may say, that since these lines lie in the same plane and are parallel to each other, they must also be parallel in Fig. 496*a*; hence we conclude that we are correct in drawing the line $e_5\ f$ parallel to $v\ a$. The same reasoning applies to the line $e_3 f$.

Here then we have found the position of the line $e_5 f$ in Fig. 496*a*, without first finding two points in this line; but if we had not known that $e_5 f$ must be parallel to $v\ a$, we then would have been obliged to find first two of its points, and then draw the line through these points.

607. Let us now consider how we could have found two points in the line $e_5 f$. We know that the line $v_2\ b_2$ represents an edge of the pyramid. Now, the cutting plane cuts the edge $v_2\ b_2$ in the point f_2; hence this point is the horizontal projection of the upper end of the line $e_4 f_2$. The vertical projection of the point f_2 must lie in the line $v\ b$, because the lines $v\ b$ and $v_2\ b_2$ represent one and the same edge; hence all that remains for us to do is to locate the point f on the line $v\ b$, and this is done in the following manner: From the point v_2 as a center, and with a radius equal $v_2 f_2$, that is, the distance from the point v_2 to the cutting plane, describe an arc $f_2\ h_2$, cutting the line $v_2\ a_2$ in the point h_2; through this point draw a vertical line, meeting the line $v\ a$ in the point h, and through h draw a horizontal line, cutting $v\ b$ in the point f; this point will, of course, be the vertical projection of the upper end of the line $e_5 f$. We have already found the point e_5; here then we have two points, e_5 and f, of one and the same line, therefore a straight line joining these two points must be the required line $e_5\ f$, and, if drawn correctly, will be parallel to the line $v\ a$, as before. The section $f\ e_5\ e_3$ is parallel to the vertical plane of projection; we therefore see the true outline of this section.

Directions.—On a separate piece of paper draw full size the vertical and horizontal projection of a pyramid with a base four inches square, altitude seven inches. In Fig. 496 the diagonal $a_2\ c_2$ should be drawn horizontally, which indicates that two edges ($v_2\ a_2$ and $v_2\ c_2$) of the pyramid are parallel to the vertical plane of projection. Draw the line $e_4\ e_2$ parallel to $a_2\ c_2$; the distance between these is to be one inch ; find the vertical projection of the section made by the plane represented by the line $e_4\ e_2$.

The quickest way to find this section is, of course, by the method given in Art. 606. But it will be better practice for the student to find the point f, as explained in Art. 607; if then the line $e_5\ f$ thus found is parallel to $v\ a$, and $e_3 f$ parallel to $v\ c$, the construction is correct; otherwise, it is wrong, and should be corrected.

Problem 93.

608. Let $v\ a\ c$, Fig. 497*a*, be the vertical, and $v_3\ a_3\ b_3\ c_3\ d_3$, Fig. 497, the horizontal projection of the same pyramid shown in Fig. 496*a*, and occupying the same relative position to the planes of projection ; let the line $e f$ represent the cutting plane perpendicular to the vertical plane of projection, and inclined to the horizontal plane of projection to such an extent as to make it parallel to the edge $v\ a$ of the pyramid ; it is required to find the section made by this plane.

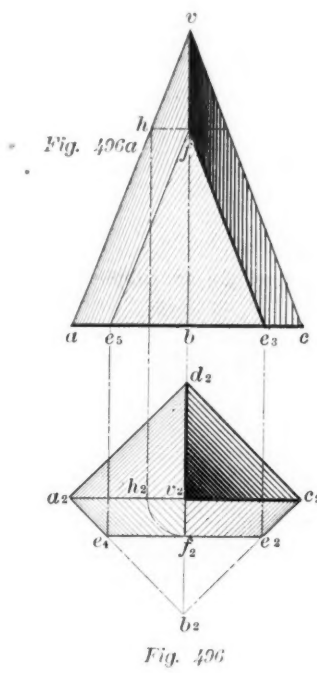


Fig. 496a

Fig. 496

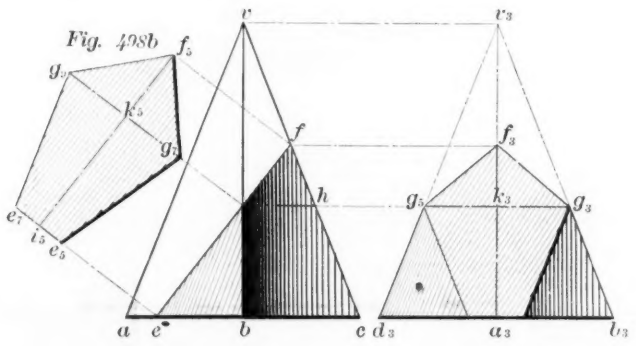


Fig. 498a

Fig. 498c

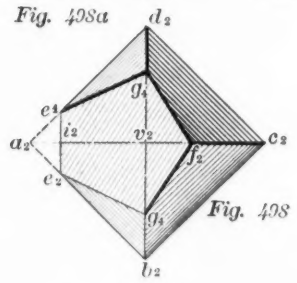


Fig. 498

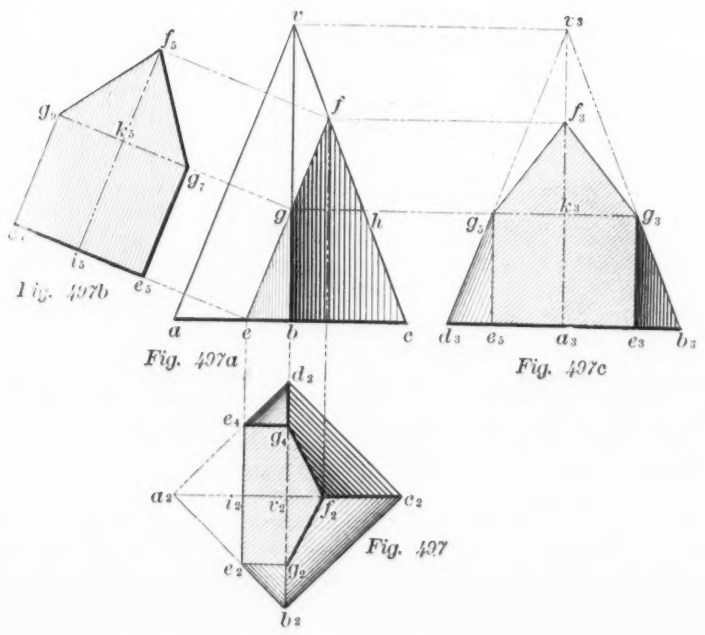


Fig. 497b

Fig. 497a

Fig. 497c

Fig. 497

Through the point e, Fig. 497*a*, draw a vertical line, cutting $a_2\ d_2$ and $a_2\ b_2$ (Fig. 497) in the points e_4 and e_2; through these points draw lines parallel to $a_2\ v_2$, meeting the line $d_2\ b_2$ in the points g_4, g_2. Through f draw a vertical line, cutting $a_2\ c_2$ in the point f_2; join the points g_4 and f_2, also g_2 and f_2, by straight lines ; the polygon $e_2\ e_4\ g_4\ f_2\ g_2$ will be the horizontal projection of the required section.

The correctness of this method can be proved in the following manner: The line $e\ g$, Fig. 497*a*, represents the intersection of the cutting plane with the lateral face $v\ a\ b$; and since the lines $e\ g$ and $v\ a$ lie in the same plane, and are parallel to each other, it follows that in Fig. 497 the lines $e_2\ g_2$ and $v_2\ a_2$ (which are respectively the horizontal projections of the lines $e\ g$ and $v\ a$) must also be parallel to each other. The same reasoning applies to the line $e_4\ g_4$. Here, then, we have found the position of the line $e_2\ g_2$ in Fig. 497, by simply finding one of its points, namely, e_2. Now let us examine the manner of finding the horizontal projection of the line $g f$. The line $g f$ (Fig. 497*a*) represents the intersection of the cutting plane with the lateral face $v\ b\ c$, and, like the line $e\ g$, it is parallel to the line $v\ a$. But the simple fact that the line $g\ f$ is parallel to the line $v\ a$ does not give us the right to say that their horizontal projections must also be parallel. A comparison of the lines $v\ a$ and $g f$ with the lines $v\ a$ and $e\ g$ may make this assertion plainer. The lines $v\ a$ and $e\ g$ are the projections of two parallel lines in space; and lines in space which are parallel to each other will lie in one and the same plane. That these lines lie in one plane is readily seen in Fig. 497*a* ; $v\ a$ is the side of triangle or lateral face $v\ a\ b$, and $e\ g$ is the intersection of the same lateral face with the cutting plane; hence; the lateral face $v\ a\ b$ contains both lines $v\ a$ and $e\ g$. On the other hand, the lines $v\ a$ and $g\ f$ do not lie in the same plane; the line $v\ a$ lies in the plane $v\ a\ b$, whereas the line $g\ f$ lies in the plane $v\ b\ c$; consequently, the lines $v\ a$ and $g f$ cannot be the projections of parallel lines in space, and therefore their projections cannot be parallel in both planes of projection, or, in this particular case, cannot be parallel in Fig. 497.

Again, it will be seen that the line $g\ f$ is not parallel to any one of the sides of lateral face $v\ b\ c$, and therefore the horizontal projection of the line $g\ f$ cannot be drawn parallel to any one of the sides of the lateral face $v_2\ b_2\ c_2$ in Fig. 497 ; consequently, before we can draw the line $g_2\ f_2$, which is the horizontal projection of $g f$, we must find two of its points. The point g in Fig. 497*a*, and g_2 in Fig. 497, are the projections of the upper extremity of the line $e\ g$, and since the lines $e\ g$ and $g f$ meet in this point, the point g_2 in Fig. 497 is one of the points sought; and the point f_2, in which the vertical line through f cuts the line $v_2\ c_2$, is the other point sought; hence, the line joining the two points g_2 and f_2 must be the horizontal projection of the line $g\ f$. Similar remarks apply to the line $f_2\ g_4$.

609. The true form of the section is not seen in Fig. 497, because the plane of this section is not parallel to the horizontal plane of projection. The true form of this section is seen in Fig. 497*b*. The method for finding the outline in Fig. 497*b* is similar to the method for finding the sections shown in Figs. 495*b* and 488*b*, in previous papers, and further explanation is unnecessary. We will simply draw attention to the fact that the lines $e_7\ g_9$ and $e_5\ g_7$ must be parallel, because the lines which they represent, namely, $e_2\ g_2$ and $e_4\ g_4$, in Fig. 497, are parallel, and that the distance between the lines $e_7\ g_9$ and $e_5\ g_7$ must be equal to that between the lines $e_2\ g_2$ and $e_4\ g_4$.

610. Sometimes it may be desirable to draw another elevation of the pyramid and its section, as shown in Fig. 497*c*. To do so we proceed as follows: At any convenient distance from Fig. 497*a*, draw a vertical line $v_3\ a_3$, (Fig. 497*c*). Through v draw a horizontal line, cutting $v_3\ a_3$ in the point v_3. Also prolong the line $a\ c$, cutting $v_3\ a_3$ in the point a_3 ; make $a_3\ b_3$ equal to $v_2\ b_2$ (Fig. 497), and $a_3\ d_3$ equal to $v_2\ d_2$; join the points d_3 and v_3, also b_3 and v_3 by straight lines, and thus complete the second elevation of the pyramid. To find the section, we simply draw a horizontal line through the point f, cutting $v_3\ a_3$ in the point f_3. Again, through the point g draw a horizontal line, cutting $v_3\ d_3$ and $v_3\ b_3$ in the points g_5 and g_3. Through these points draw the lines $g_5\ e_5$ and $g_3\ e_3$ parallel to $v_3\ a_3$; and join the points g_5 and f_3, also f_3 and g_3 by straight lines, and thus complete the outline of the section. If correctly drawn, the distance between the lines $e_5\ g_5$ and $e_3\ g_3$ will be equal to that between

the lines e_2 g_2 and e_4 g_4 in Fig. 497. In Fig. 497*c* we do not see the correct height of the section, because its plane is inclined to the vertical plane of projection; but we do see the correct width of the section.

Directions.—In the space marked Prob. 93, draw the vertical and horizontal projection of a right pyramid, as shown in Figs. 497 and 497*a*. The base of the pyramid is 4 inches square; altitude, 7 inches. At 1¼ inch from the edge *v a*, and parallel to it, draw the line *e f*, to represent the cutting plane. Find the section made by this cutting plane as shown in Figs. 497 and 497*b*. Also, find another elevation of the pyramid and section as shown in Fig. 497*c*. Use a 3 inch scale.

611. Figs. 498*a*, 498, and 498*c* represent a pyramid of the same size as the two former ones, and occupying the same relative position to the planes of projection as the others. The cutting plane *f e* is not parallel to any of the edges; it is required to find the section in the different views.

This problem is simply given for practice, and it is left for the student to work out; no difficulty should be experienced in doing so, provided the manner of working out the previous problems is understood. It may be remarked here that no two lines in the outline of the different views of the section are parallel.

Directions.—On a separate piece of paper draw full size the vertical and horizontal projections, as shown in Figs. 498 and 498*a*, of a right pyramid with a base 4 inches square, altitude, 7 inches. Draw the line *e f* so that *v f* is equal to 3 inches and *a e* equal to ½ inch. The line *e f* represents the cutting plane. Find the section made by this plane. Also find a second elevation as shown in Fig. 498*c*.

Automatic Self-Feed Dovetailing Machine.

This engraving illustrates the No. 1 Stengel's patent automatic dovetailing machine, made by J. A. Fay & Co., and exhibited by them at Paris—a machine which has acquired a high reputation among cabinet and furniture makers for making dovetails in drawers, boxes, etc. It is simple and substantial in its construction, automatic in its operation, and perfect in the work produced. It will work up to 16″ wide, or receive and work two 8″ drawer fronts and sides at one time.

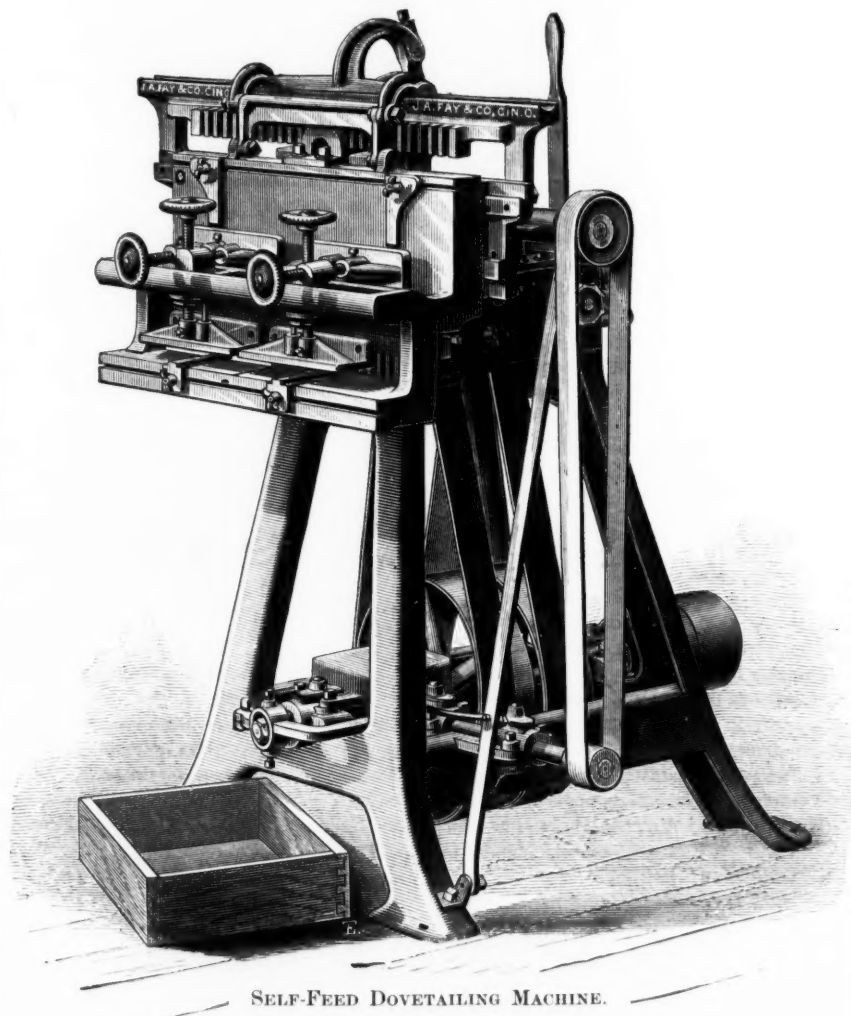
In operation, the material to be worked is placed upon the feeding carriage, and secured by means of clamps, one piece being held in a horizontal, and the other in a vertical position. The carriage is traversed up and down in dovetail guides on an intermediate traveling plate, which also has a horizontal movement upon suitable ways. A slotted yoke secures the vertical adjustments for regulating its up and down movement. This yoke is provided with a fixed guide, which moves in the vertical grooves or comb between the ribs on the fixed plate. The vertical side of the lumber carriage is also provided with a comb, to allow the cutting tools to pass through between the teething to the lumber. After the material has been placed in the machine, and it is started, the carriage moves automatically, feeding the work to the cutting tools.

One of the distinguishing features is that the carriage may be stopped and started at any point and returned, or will work its full stroke, and after the material worked is removed, and fresh pieces put in, in its backward movement it will repeat the operation. This is a saving in time, as it cuts while the carriage is traversing in both directions. The cutting tools are mounted in arbors which revolve in self-oiling boxes, carried in independently adjustable sliding frames; the arbor pulleys are to be driven by two belts, from the driving pulley below. The length of the dovetail is controlled by adjusting the cutting spindles at the rear side.

The feeding carriage always stops at the extreme upward throw of the crank, and at the extreme right or left-hand end of the rack. This admits of dovetails being made both during the forward and backward movement of the carriage; whereas, in former machines, it was necessary to return the carriage by hand to the starting point, and they could only be formed while the carriage was traversing in one direction. A peculiar arrangement of the mandrel and dovetail cutters is such that they may be easily adjusted to cut larger or smaller, by simply turning them in the mandrel. When the material is inserted in position, and the machine started, the carriage moves automatically, vertically and longitudinally, making at each revolution of the crank-wheel a perfect dovetail and joint, and continues to perform the operation until the work is completed, when it automatically stops, and one side of the tenons of each horizontal piece of lumber will be rounded to fit the rounded inner ends of the mortises cut in the vertical pieces.

The feed carriage is actuated back and forth by means of cup frictions, which are always under complete control of the operator. The machines are supplied with countershafts. The tight and loose pulleys are 6″x3″, and should make 900 revolutions.

The National Bank of Commerce, of this city [Pittsburgh, Pa.,] has just contracted with the Detroit Safe Company, of Detroit, Mich., for the construction of the strongest burglar proof vault ever built. The bank has a large amount of money on deposit, and, to make it absolutely secure, invited safe companies to propose a plan for a vault which should be burglar-proof beyond question. The contract was awarded, as above, through the vice-president of the company, Mr. A. S. Wiley, who designed the vault and submitted plans. The vault will be of steel, will have metallic walls 14¾ inches thick, weigh over 100 tons, and cost in the neighborhood of $25,000.—*American Manufacturer.*



SELF-FEED DOVETAILING MACHINE.

Sir James Kitson, in his address as president of the Iron and Steel Institute, mentioned that his father, the well-known locomotive builder, more than fifty years ago wanted a fire-box plate of the then unprecedented weight of 500 pounds. The manager of the Low Moor Works undertook the job; but he said the plate was so big that he could give no guarantee, and could only promise to do his best. The plate was, however, made. At the present time Cammell & Co. have rolled a plate weighing sixty-five tons.

Exposition Notes.

Editorial Correspondence.

I failed to mention in a previous letter, in which steam engine exhibits were referred to, the fact that Stevenson's *Locomotive* of 1825, and his *Rocket* of 1829, are both on exhibition, having been loaned for the purpose by the museums to which they belong. These engines are curiosities in their way, but of far greater interest than these, and of greater historical importance, is Trevithick's engine of a quarter of a century earlier date. For reasons that it is not easy to understand, the work of this great engineer has received scant recognition, hence this old relic of his skill—nearly one hundred years old—is especially interesting. It shows not only a knowledge of the use of high-pressure steam, as all steam at that time with which work was done above the pressure of the atmosphere was called, but a good deal of mechanical skill is shown in the constructive details. From the best evidence to be found, Trevithick in England, and Evans in America, were contemporaneously working at the problem of using high-pressure steam, each ignorant of what the other was doing. Had mechanical knowledge been interchanged then as it is now, a great deal more would have come from the efforts of these two men. The achievements of these two men have been quite overlooked, and they have been belittled by showing that others had conceived the possibility of doing what they did; so plenty of men have dreamed of crossing the Atlantic with the speed of an express train, or traversing the air at will, but the honor belongs to him who achieves something in these directions. There is a world of humbug in this going back and showing that some one had conceived the possibility of a thing being done that another has accomplished. It requires no skill—mechanical or otherwise—to put oneself on record as believing a voyage to the North Pole practicable. Trevithick attempted to use his engine as a locomotive, but he did not meet with much success. But he did make a steam engine almost enormously cheap in comparison with other engines of the day, and the engine by him at the Exposition is a practicable machine in every respect. It was the outcome of a need for something that could be used by mine owners of moderate means. Here, as is generally the case, invention waited upon the necessities of civilization. The price of the cumbersome engines of Bolton & Watt was beyond the means of the small mine owners, and the high-pressure engine, capable of freeing the mine of water at small original cost, was a blessing to the common people. It knocked the prop from under monopoly.

Trevithick's engine at the Exposition has a cylinder, I should think about 12″x30″. The outside shell of the boiler is of cast-iron, with internal fire-box. The cylinder is vertical, and is in the front end of the boiler, cast in one piece with the boiler shell. The casting is a very creditable one; many poorer castings are made every day. The crank-shaft is 4½ inches square—after the custom of the day—and the fly wheel is 9 feet in diameter, with counterbalance cast in. The connecting rod is made up of two wrought-iron straps and wood filling, the ends of the straps projecting beyond the wood to form the jaws for the boxes. The crosshead guides are of round iron, about three feet apart. The feed pump is worked from the crosshead by means of a rod and a lever, to reduce motion. The pump is provided with an air chamber, and looks very much like a good many pumps made at the present day. The exhaust from the engine is in the stack, and the exhaust steam passes through a feed-water heater before entering the stack. Altogether the engine shows that Trevithick possessed a good deal of knowledge in steam engineering, and, in my opinion, is superior as a machine to those by Stevenson, made twenty-five years later; by very slight modification it could be converted into a locomotive, and it was probably one similar to it that Trevithick used on a railway in 1805.

In wood-working machinery J. A. Fay & Co.'s exhibit undoubtedly takes the lead. They have a large number of machines well located, and they show them in operation, and this tends to make their space the center of a good deal of attraction. There are some large exhibits of European wood-working machinery, some of it very good, but on the whole their machinery seems to lack the completeness of the American machinery; they more frequently leave a job to be completed by hand that the American machine would finish outright. Judging by Fay & Co.'s exhibit in comparison with others at the Exposition, it seems safe to say that American wood-working machinery is the best in the world.

The speed of the American machinery is generally higher than that of European machinery, enabling materially more work to be done. It is quite an interesting study to watch the expert operator in Fay & Co.'s exhibit. It gives one about the best idea possible of the enormous economical advantage of the use of machinery in this department of industry.

It is apparent that much greater use is made of some other than plain gearing in Europe than in America. In cast gearing the "herring-bone" tooth is a favorite, and some splendid examples of it are to be seen in both iron and steel. A Paris exhibitor—A. Prat—has a very noticeable exhibit of this kind of gearing. One half-wheel, 14 feet or more in diameter, 6 inches pitch, is a remarkably fine example of clean foundry work. Then there is a bevel wheel about 4 feet diameter, that is about as smooth as if finished. This firm exhibit a great variety of odd forms of gearing other than herring-bone, such as spiral bevels, large spiral cogged, spiral racks and pinions, elliptical gearing, and forms too numerous to refer to. The castings are good enough to be called perfect, from the teeth of the wheels to the cored holes. A good many machines are to be seen running in which the herring-bone system of toothed wheels is used; generally, but not always, these wheels run very smoothly.

Next to herring-bone gears spiral gearing appears to be the favorite. Continental engineers seem to use this in reason and out of reason. It is used in pairs—right and left—when the endlong thrust will be balanced, and it is used in places where about the only reason for using it appears to be the creation

of useless endlong thrust. Spiral gearing runs very smoothly when made and set absolutely correct, but in America the objections to it have been such that it has nearly gone out of use. Lathes were built in America more than thirty years ago, in which the back gears were cut spiral.

One of the most instructive exhibits is that of the Leeds (England) Forge Company. They show a marine boiler head 14 feet in diameter, made of steel about ¾ inch thick, flanged around for riveting and for three furnaces, all done at one operation by hydraulic machinery. They also exhibit tender frames, truck frames, car side frames, and other forms worked, flanged and formed up in the same way. There is, in the present knowledge of the art, nothing wonderful in the fact that this can be done, but the fact that machinery heavy enough for such work is in use is of interest, and the excellent character of the work done is sure to attract the attention of American visitors. The immense pieces formed in this way are worked in all their parts at an even temperature, and being thus worked and cooled evenly, must be without damaging internal strains. This firm is also the manufacturers of the Fox corrugated boiler flues, so largely used for furnaces of marine boilers. Several of these of large diameter were on exhibition.

I have referred to the general excellent character of the castings at the Exposition. I do not know how much of this—if any—comes from better workmen, and how much from taking more pains with the work, but it is a fact that you seldom see the marks of trowels and sleeks on the bed-plates or frames of machinery, and the absence of such marks improves the general appearance. Sound bold edges are the rule. I refer more particularly to castings made in France and Belgium.

The American Machinist has previously referred to the absence of anything like an attempt at a display of steam pumps in operation. I cannot help thinking this is a mistake, as such an exhibit, when the work done by the pumps can be clearly observed, is both interesting and instructive.

There are, of course, several small steam pumps used as boiler feeders, but these cannot be said to be on exhibition hardly more than the safety valves on the boilers. Besides these there are a few others scattered over the space, but there is nothing in the shape of a concerted exhibit. It seems evident that the American types of pumps are preferred in Europe, and this opinion seems to be borne out by the fact that an American type of pump is used for general purposes at the Exposition more than any other. Departure from these types seemed in the direction of introducing clumsiness and needless complication.

There are two pumping engines at the pumping station of the Exposition. One of these is a Worthington high-duty engine, with a capacity of 6,000,000 gallons. This engine does its work with the usual quietness of these machines. Another—a French machine about half as large—is a pump connected to the extension of the piston rod of an engine of the Wheelock type. Whatever the trouble in the water cylinder may be, every stroke of the piston produces a noise that savors of impending dissolution.

The American Screw Company illustrate their process of heading and rolling threads on wood screws. They have a heading machine and a machine for threading the blanks. They are working No. 9 (screw gauge) steel wire. The heading machine forms the head at three blows, one of which makes the nick for the screw-driver. This nick does not extend quite across the head, a little metal being left at each end. As the threading dies raise the gauge from 9 to 13, a head must be made on No. 9 wire to correspond with a 13 gauge screw, and it has so far been found necessary in America to import the steel rods from which the wire is drawn. This, not only on account of quality, but cost as well, the object in making screws by this process being to produce superior screws at less cost. A great deal of money has been expended in experimenting with this machinery, which, it is now believed, is practically perfect. The first heading tool that strikes the wire simply enlarges it at and near the bottom of the heading die; this relieves the gripping dies of part of the duty of holding the wire while the head is formed, a duty greater than usual from the fact, as before stated, that a No. 13 head is made on No. 9 wire. The two succeeding blows complete the head and make the nick, no shaving or other work being required. This machine also points the screw ready for threading. The threading dies are two steel bars properly formed for the purpose for about eight inches of their length. These dies are given a rapid reciprocating motion in opposite directions. The relative motion of these dies must be exactly alike, when, as will be seen, the blank will have no motion except that of revolution. In the first inch movement of the dies, the full depth of the thread is cut; then, during the rest of the traverse of the dies, the thread is gradually rolled up to proper shape, the bottom of the thread being but little below the body of the blank, the finished screw being practically of equal strength throughout its length.

It may be incidentally mentioned that patents have been issued to those interested in the manufacture of screws by the ordinary processes for reducing the diameter of the body of screws above the thread, so that, instead of the raising of the thread above the body of the blank being objectionable, it is claimed that it is advantageous to do so. The blank passes vertically into a chamber above the dies, and, while being threaded, is held down by pressure of oil on the head, a small pump being used to create and maintain the pressure. The machine at the Exposition rolls 1½-inch screws at the rate of nearly one per second. The material of which they are made is extremely tenacious. The blanks or finished screws can be bent double and hammered out to extreme thinness without break. The screws also have a point superior to any I have ever seen cut by ordinary processes, and in driving have less tendency to split the wood. The head is also superior in strength, owing to the holding power of the metal at the ends of the slot.

John Thomson exhibited printing presses—what is known as the Colt's Armory Press—and water meters of various sizes. One of his meters is shown in operation under a glass case, the water entering the case and standing at a height representing the surprisingly small head under which the meter will work—a small fraction of a pound in the instance of an inch meter.

The Campbell Printing Press Company also exhibit presses and pipe wrenches. They were troubled in getting power to run these presses, and Mr. Thomson met with similar trouble in getting steam for the Baxter engine with which he operates his presses.

The "largest belt" is not on exhibition—at least I have not seen it—but there is a belt six feet eight inches wide, and three-quarters of an inch thick, made up of narrow longitudinal strips sewed together transversely.

H.

Bristol's Steel Belt Fastening.

The accompanying engravings illustrate a new type of belt fastening, which is being manufactured and placed upon the market by the Bristol Mfg. Co., of Waterbury, Conn., which, on account of its resemblance in appearance and elasticity to the ordinary leather lacing, is called by them the "Steel belt lacing." It may be quickly and easily applied, without the use of any special tools, making a light, smooth and elastic joint, thus doing away with a large amount of the annoyance and delay incidental to the ordinary method of lacing belts with leather.

The Bristol fastening consists of a continuous zigzag strip of steel, having spurs alternating on opposite sides of a longitudinal center line, and bent at right angles as shown by Fig. 1, in which the fastening is represented as placed on the ends of a belt about to be joined. The spurs having been driven through the belt and clinched on the inside, the finished joint will appear as represented in Fig. 2.

The spurs should be driven through upon a piece of soft wood; then by laying the smooth side of the joint upon the face of the pulley or any convenient piece of iron, the points may be clinched.

It should be observed that the zigzag or lace-like form of the blank of this fastening

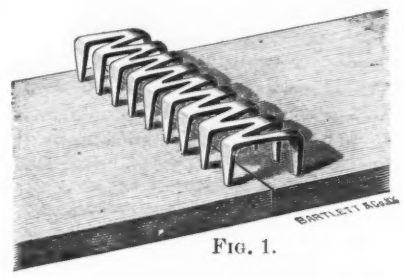


Fig. 1.

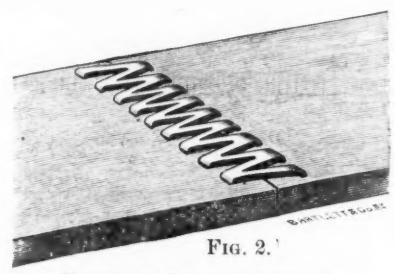


Fig. 2.

Bristol's Belt Fastening.

renders it elastic and flexible, so that, when applied, it readily accommodates itself to the crown of the pulley or the twist of a crossed belt.

As the fastening is narrow, a slack belt can be taken up a very small amount if desired. They are made of various lengths up to three inches, to correspond to the standard widths of belting, and are put up in packages of one hundred inches each. For extra wide belts, two or more fastenings may be used.

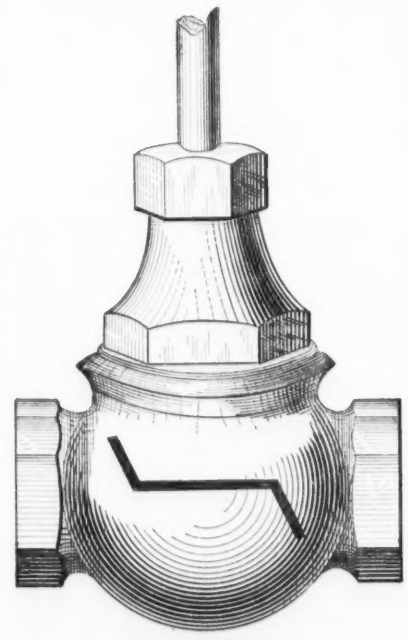
The fastening was devised by Prof. W. H. Bristol, of Stevens Institute of Technology, who, in determining the proper proportions for it, made a large number of experimental fastenings, put them into pieces of belts, and pulled them apart. He thus determined the best possible relation between the width of steel spurs and the spaces between them, and arrived at the best proportions generally. Some of them have been in use continuously during the past five months, under circumstances calculated to put them to the most severe practical test, their performance being entirely satisfactory.

LETTERS FROM PRACTICAL MEN.

Globe Valves.

Editor American Machinist:

Probably nothing is more common or well known among engineers than the ordinary



Globe Valve.

globe valve, and varying as the ability of the men in charge is their durability and satisfactory working. This statement should be modified by "other things being equal," for there are some globe valves in the market, made of such poor material, put together so crudely, and withal so sparing of metal, that, like a pair of "hand-me-downs" pants, they may be expected to be dear at any price. Where the engineer has anything to say about the supplies—and he should interject a word—it is safe to say that such goods will not appear. Even should those who buy because the goods look nice, and the price is low, persist a few times, the same lesson will be impressed on that most tender portion of one's anatomy—the pocketbook.

Excepting the removable disk there has been no radical improvements in the globe valve, yet there has been an elegant evolution from the poorly designed to the beautiful article now made by our best manufacturers. Naturally the question arises—Have we reached perfection in this line? Believing there is room for further improvements has suggested this article.

Practical observation shows that it is perfectly useless to expect men to put on globe valves the same way. The arguments ready for either side should be sufficient to show that each way—pressure on top or pressure under the disk—will always have its devoted adherents, and, like the Irish jury's verdict—each side is right and both wrong. One could heartily wish that on this subject we had a U. S. standard, especially when you take charge of a plant where you can't tell how the preceding engineers were divided on putting on the valves. For such conditions I evolved the following plan, which may or may not be new to others, but is certainly original so far as I am concerned. I suggest that a profile of the valve seat be shown on each side of the body of the valve—either recessed in or projected out—but set like the valve seat itself. By means of this one could always tell, even in the dark, just how a valve was put on, and yet it would not add materially to the cost of the valve. When you consider how handy this would be to steam-fitters, engineers, etc., one wonders that it has not been in use before this. This should show on both sides.

Another suggestion would be of value in the practical operation of the valve: Mill off the back of the disk, and the corresponding part of the stock, so that when the valve is open full wide the disk will make a tight joint on the inside of the stock, and thus allow the gland to be packed. This work would not cost much, and yet would add much to the value of the valve to the operator, for it is true that always one prefers to open the valve to its fullest capacity when packing, and, indeed, with some make of valves it is impossible to pack without doing so. It is not necessary to further push the advantages of these suggestions, as they are apparent to the practical steam user, and it remains to say that it is the wish of the writer that valve manufacturers will adopt these plans, or an improvement on them. Some of these days, when I start a happy-go-lucky job shop—where one can tinker to his heart's content—I shall put in the market a valve that will largely diminish the amount of profanity now used.

T. T. Parker.

Lathe Centers.

Editor American Machinist:

In your issue of Aug. 1st, on page 8, I notice an item regarding lathe centers, stating that those of European make at the Paris Exposition are universally turned to forty-five degrees, but that American tool builders are convinced that sixty degrees is a better angle.

I presume ninety degrees is to be understood, instead of forty-five, as further on you state that the average lathe hand is inclined to "stunt the angle," making his centers nearer forty-five than sixty degrees.

American tool builders—some of them—may be convinced that sixty degrees is just the proper angle, but a man who gets his living turning shafting or car axles is just as thoroughly convinced that it is *not* the correct angle; for in this case the center acts partly as a step bearing, and must hold the oil.

I have found it the universal practice in general jobbing shops to turn centers to about seventy-five, with a variation of a few degrees either way. On small, light work,

sixty degrees is preferred, and on very small, fine work, fifty degrees is not uncommon.

The reason for this seems to be that a good substantial center may be put in a small piece without making the hole too large. A sharp center acts more like a parallel journal when holding light work, as there is very little end thrust to be overcome, and the resistance opposed to the thrust of the cut taken by the tool is opposed by a wearing surface nearer abreast the tool with a sharp center than with a blunt one. Now, regarding "the disposition of workmen in re-turning centers to stunt the angle." When heavy work is done, a blunt center will hold it more rigid, requires less oiling and attention, does not demand that all centers be drilled, is not as liable to injury from rough handling, and in short, does not give a lathe hand so much trouble to keep it in good shape.

I have seen men who seemed to have more "fine hair" than good judgment, who would turn up their noses in disgust at a blunt center, regardless of the class of work it had to hold. I have seen these same men getting in more time on their center repairs than on their work, for the simple reason that they, like the tool builders referred to, were convinced that sixty degrees was the best angle.

There cannot be any such thing as a standard angle for centers, which will give satisfaction on all kinds of work, any more than a certain *size of lathe* will do for all kinds of work.

A $\frac{3}{16}''$ center (60°) in a $\frac{1}{2}''$ rod looks well, and is about right for any ordinary turning which might be done on such a piece. If we wish to turn a 12″ shaft on a sixty-degree center, and have proportionate wearing surface for the oil, the center hole must be $4\frac{1}{2}''$ diameter, which would hardly look well, say nothing about the cost to put it in.

When a center has to hold a load of one or two tons, it has got to be shoved in pretty tight, and the sharper it is, the easier it will crowd out the oil.

Lathe hands who aim to do lots of work, and have a great deal of rough wrought-iron center work, generally have two center punches, one having its point *turned* to same angle as lathe centers (this is a good solid punch, on which a sledge may be used if necessary); the other one ground a few degrees sharper, to relieve the point of the center and save the time of center drilling; but when you get a secondary center punch ground down sharp enough to relieve a sixty-degree center, it possesses a disagreeable habit of breaking off in the hole, thus pointing to the fact that it is better to *drill* centers for small work.

W. H. CHAPPELL.

[The writer of the item to which Mr. Chappell refers happens to be one of those fellows who has earned "a living turning shafting and car axles" and the like, and has never found occasion to grumble at the standard American taper for centers. He also believes that all centers should be of the same taper, and that every center in work to be turned should be drilled. Giving the angle at 45° instead of 90° was a mistake, pure and simple. Fortunately it was not one of the mistakes that confused any one. Our correspondent's notice is just about the fortieth calling attention to the same error We are obliged to every one who wrote us in regard to it.]

Proposed Process for Rolling Rails and Shapes.

We have referred, in a previous issue, to a plan for making rolled steel forms direct from the molten metal, that is, without the intermediate process of casting into ingots. Those who are interested in this plan for manufacturing believe that by the processes they propose, not only will the cost of manufacture be very materially reduced, but that a superior product will result. As we have before said, a modification of the process hereinafter described has been employed for rolling soft metal into continuous sheets. The engravings herewith illustrate recent patents issued to Edwin Norton and J. G. Hodgson, 44 River street, Chicago, the object being to provide for rolling steel and other dense metal forms.

The engravings conform to patent office custom and are right side up when page is turned one quarter round toward the right. It is proper to say that an underlying principle is to subject the molten metal to pressure between rolls, the conformation of the first rolls being such as to compress the flowing metal into very nearly the shape of the finished form; subsequent rolling is continuous, and in a direction to bring to exact size, and to further compress the metal, also that the speed of the rolls is such as to prevent damming of the metal; that is, the speed is such as to provide for a continuous stream of practically a constant cross-section. It will be understood that there is very slight pressure on the initial rolls; these rolls are kept cool by interior water circulation.

In the engravings, Fig. 1 is a plan view of the apparatus devised, and Figs. 2, 3 and 4 are, respectively, a central horizontal section through the axes of the rolls, a vertical section on 3, 3, of Fig. 1, and a side elevation partly in section. Referring to these engravings it will be seen that the first rolls—in this instance four in number—are formed at their peripheries so as to present a space between them similar to the section of an ordinary rail. Directly over these rolls the molten metal passes to the rolls through the spout or channel.

The following, which we take from the patent specifications, will make the matter entirely plain:

As indicated in Figs. 1, 2, 3 and 4 of the drawings, the working or meeting faces or peripheries of the rolls B are given a shape or configuration to form an ordinary railroad rail. They may, however, be shaped to give the space or passage b any desired cross-section, and thus produce a bar of any form required. The rolls B have beveled faces b', which meet or roll against each other, and serve as stops for the several rolls against each other, so that the space or passage b for the metal will always be maintained of a uniform size, and thus produce the rail or bar of a uniform cross-section throughout. The rolls B are each made hollow, and preferably with a central web B', and the shafts B^2 are also made hollow, so that the water or other cooling fluid or liquid may be made to circulate through each of the rolls for the purpose of keeping them cool or of the desired temperature. The hollow shafts B^2 are each furnished with a packing or stuffing-box d at each end, by which they are connected with the inlet and outlet water pipes D D'. The pouring bowl or vessel C is supported by any suitable means above the rolls B during the pouring operation, preferably by standards C', furnished with adjusting screws C^2. The pouring-nozzle C is preferably furnished with a valve or device c for opening and closing the discharge passage. The hollow shafts B^2 of the rolls are all geared together, so that they revolve or roll together at the same surface speed. The gearing employed may preferably be bevel gears, such as indicated at B^3. Two of the shafts B^2 are also geared together by spur gears B^4. E is the driving shaft, having a gear E', which meshes with a gear E^2 on one of the shafts B^2. The pouring bowl or nozzle C is furnished with a guide or shield C^3 extending down to near the meeting point of the rolls. This is designed to prevent the metal from splattering at the beginning of the pouring operation. A greater or less number of rolls than four may be employed.

F represents a second series of rolls, arranged preferably directly below the chilling rolls B, and between which the bar x passes as it issues from the chilling rolls B. The series of rolls F are preferably of the same form and construction as the rolls B, being hollow and having the same connections for passing water through them, so that they may operate as chilling rolls as well as to further roll, compress and finish the rail or bar produced. The rolls F may, however, be of any ordinary or known construction. The series of rolls F is preferably like the series B, composed of four rolls revolving together.

G is a curved guide or conveyer, consisting preferably of a series of rolls or idle pulley wheels, arranged in a curved path to curve and guide the bar as it issues from the rolls F to the horizontal conveyer or series of rolls H. Some of the rolls H are preferably driven and operated to further roll and straighten the rail or bar, as well as to convey it along or away. The curved guide G also affords some slack in the rail or bar between the chilling rolls and rolls H H, to compensate for difference in speed or slipping.

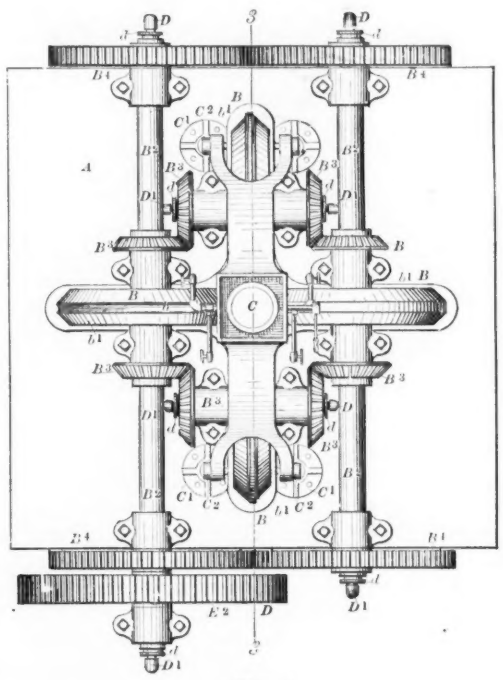


Fig. 1

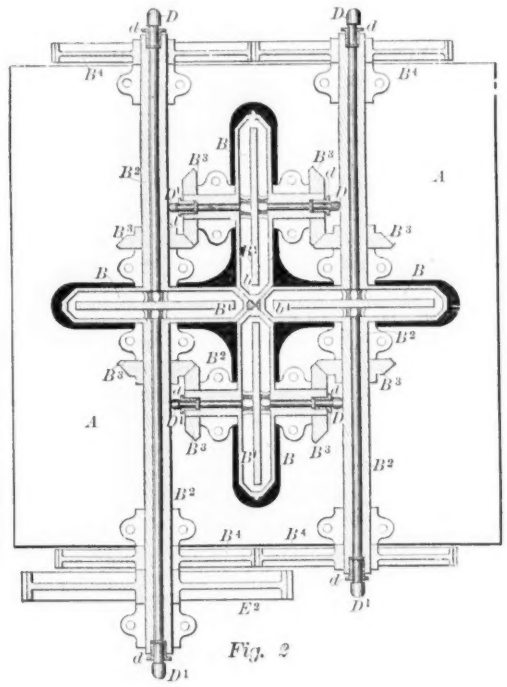


Fig. 2

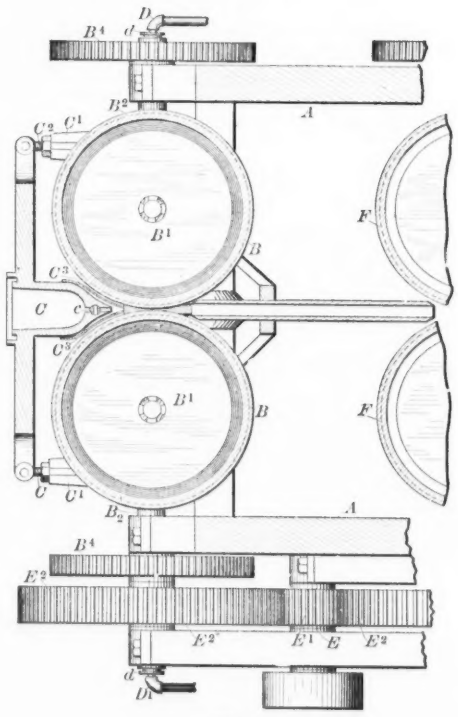


Fig. 3

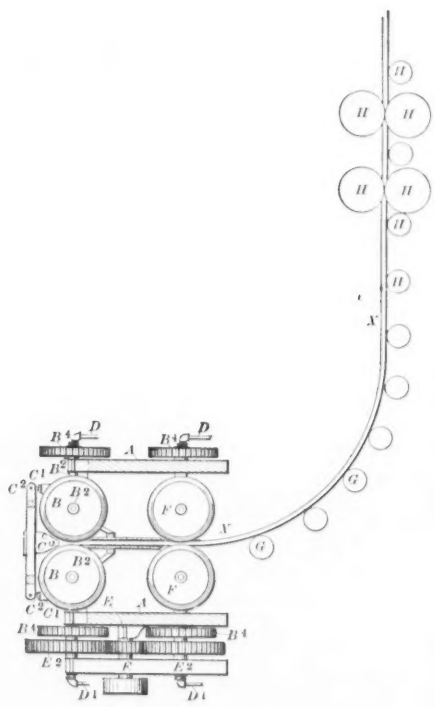


Fig. 4

PROCESS FOR ROLLING RAILS AND SHAPES.

A Question of Economy.

An order was recently given to Henry R. Worthington for a pumping engine of the type illustrated on the first page of this issue, which illustrates a principle that is fast gaining ground in such matters, and will lead eventually to the much more general seeking for the greatest possible economy in steam plants. The engine of which we speak will be used for the water-works pumping station in the new town which has been started by the Westinghouse people in connection with their large new works near Pittsburgh, and will be triple-expansion, the most economical pumping engine ever built by the Worthingtons. The same men who control the company ordering this engine, control a very large proportion of the natural gas fields about Pittsburgh, and at first thought it seems a little strange, or at least a remarkable coincidence, that the men who can best afford to be careless in the matter of fuel economy should order an engine calculated to secure the greatest economy ever attained by a pumping engine built by the Worthingtons. The circumstance ought to be very suggestive to others putting in steam plants, whether for pumping water or for other purposes. Of course the Westinghouse people have a market for all the gas not consumed by themselves, and it is a simple matter of arithmetic to decide whether the extra expense involved in securing a triple-expansion engine of given guaranteed economy above that which can be guaranteed for a two-cylinder compound, will be more than made up by the saving in gas at a given value per thousand feet, or not. That the figures in such a case give an affirmative answer to the question is very strong evidence that many thousands of dollars are being thrown away by comparatively wasteful steam plants, which could as well be saved. The tendency toward the employment of the most economical possible steam plants is undoubtedly growing stronger every day, and those who soonest recognize the importance of it will reap the greatest benefits.

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NEW YORK, AUGUST 15, 1889.

CONTENTS.

PAGE.

Worthington High Duty Vertical Compound Pumping Engine 1
Experimental Engines 1, 2
Planer Chuck 2
Air Furnaces 2
Care of Micrometer Caliper—Opinion. By Jarno. 3
Some Points About Belts and Pulleys. By Fred J. Miller. 3
Practical Drawing. By J. G. A. Meyer 4, 5
Automatic Self-Feed Dovetailing Machine 5
Exposition Notes 5, 6
Bristol's Steel Belt Fastening 6
Letters from Practical Men: Globe Valves. By T. T. Parker—Lathe Centers. By W. H. Chappell 6, 7
Proposed Process for Rolling Rails and Shapes. 7
A Question of Economy 7
A Question of Facts 8
A Case of Toadyism 8
"The Right to an Invention." 8
Questions and Answers 8, 9
Manufactures 9
Machinists' Supplies and Iron 10

A Question of Facts.

The electrical execution inquiry affords a good example of how expert testimony can be made to appear to favor a certain predetermined position with regard to the question at issue, and no one who has given any attention to it can fail to be impressed with the extent to which commercial considerations can lead to the suppression of the truth about matters which the public have a right to understand. Many of the newspapers and technical journals continue their attempts to mislead people and prejudice the minds of those upon whom the decision of the Kemmler case devolves by magnifying and garbling the testimony which seems to favor their side of the question. At this writing much is being made of the testimony of an electrician named Smith who testified that he had received a shock from a 1,000 volt machine without being rendered unconscious. This is taken to be a positive proof that a current of 1,000 volts cannot be depended upon to kill. A man may receive a shock from the explosion of a gallon of nitroglycerine and not be killed by it, but if the full force of the explosion is exerted upon him, he will be instantly killed, and he will just as certainly be killed when he receives the full force of a 1,000 volt alternating current of electricity. Every electrician knows this perfectly well, no matter how his testimony may be made to appear, nor how well he may succeed in concealing the knowledge of the fact. We do not think that anything whatever will be gained by an attempt to mystify the public in such matters. It is perfectly well known that people are continually being killed by artificially generated currents of electricity, and hence that it will kill under certain conditions. The better those conditions are understood by the public the better for all concerned.

Mr. Smith testified that the men used to handling the machines considered a shock from a 1,000 volt machine of but little danger. In this connection it may help to clear matters somewhat by relating the case of a man who had charge of an electric light installation in this city a few years since, who was in the habit of grasping the wires in such a manner as to take the force of the current, which was some 400 or 500 volts alternating. He did this habitually when visitors expressed their fear of the machine, and evidently believed that there was no danger. One evening, after he had washed his hands preparatory to leaving for home, some one came in, he repeated the experiment in exactly the same manner as he had done many times before, and was instantly dead. Now all the mystery could be made out of this case that has been made of others. It could be made to appear that an alternating current of 400 or 500 volts would sometimes fail to kill under the same conditions which at other times it would kill, or that the physical condition of the person taking the current decided whether or not a given current would be fatal, and that the conditions were not understood by any one. The explanation of the case is that usually this man's hands were partially insulated by the oil which usually covered them as a result of his working about the engine and machinery. He was thereby well protected, and did not receive anything like the full force of the current, as he supposed he did. But when the oil was thoroughly washed from his hands, and they were yet slightly wet from the washing, they were in good condition for receiving and transmitting the current through his body, the result being instant death. The current was the same in each instance, there was simply a difference in the contact. It is perfectly safe to say that with proper contact an alternating current of 1,000 volts will instantly and certainly kill any living organism. It is also perfectly safe to say that every electrician knows this to be an absolute fact. Our interest in this matter does not arise from concern for the fate of Kemmler, nor from a special desire to have electricity used in executions; but we protest against this throwing an air of mystery about a matter which is practically well understood, when it is altogether likely that that mystery will contribute to the death of many innocent persons. It must be thoroughly recognized that many of the currents now used for electric lighting will kill, and that, if it is not desired that they shall do so, measures of protection must be adopted.

A Case of Toadyism.

A few months ago we noted that James G. Blaine, Jr., had gone to work in a machine shop for the purpose of learning the trade, and said if young Blaine or any other young man wished to become a mechanical engineer there was no better way than through the machine shop; but that favoritism or rich or eminent fathers could be of little service to them in learning. The papers now are making almost as much fuss over the fact that young Blaine has left the shop, and become a fireman on the Maine Central Railroad, as they made over his original entrance into mechanical life. Among other absurd statements made regarding the matter, is one to the effect that in the few months he has been working at the business he has "mastered it in every detail." It is bad enough for an ordinary newspaper to make such a statement, but we have seen it made in apparent seriousness in papers which might be expected to know better. We think that Mr. Blaine's son is entitled to the greatest respect, just as any other young man is who proves himself worthy of it by making himself useful. But the way in which the papers are assuming that because he has a prominent public man for a father, he has in six months learned every detail of the business which all others require years to learn, is pure toadyism, which the young man will himself despise if he has as good sense as we give him credit for. He has perhaps gone far enough to find that he does not like the machinists' trade, and has concluded to go upon the road. If he keeps on firing long enough, and does not assume that he knows how to run an engine by transmitted knowledge, he may become a very good engineer, but there are obstacles in the way of his becoming one which most young men do not have to contend against. Not the least of these will be the favoritism and toadyism which will be shown to him.

"The Right to an Invention."

Our attention has been called to the fact that the editorial article entitled "The right to an invention," in the issue of July 25, is liable to be misunderstood, because it so reads as to make its application more general than was intended by the writer.

The statements made in it are true of the particular case cited, and all others like it, but if the real inventor in that case had applied for a patent before his invention had been in public use two years, he would, of course, have been entitled to a patent, provided he could have proven that he was the actual and first inventor, and had never abandoned his invention. He would then, after receiving his patent, have been in position to contend for and maintain his rights in the United States court. The chance for misunderstanding arises from our having omitted to state this fact, and also from the fact that the language used made the inference a fair one that certain statements applied generally to all cases, which were not intended to so apply. It was a piece of carelessness on our part, for which our only excuse is that mankind (including editors) have not yet reached the condition of infallibility. We thank our friends for calling our attention to the matter.

The Erie railroad has withdrawn the publication of its time table from one of the dailies of this city, the unique editor of which has discovered and published, from time to time, several entirely new and original reasons why the Erie should pay him for having its time table published in his columns as heretofore. Among other ideas which he seems to have evolved is one, according to which the publication of a time table in a newspaper has something to do with the prevention of accidents upon the road. He says, "If other railroads were as foolish as the Erie in refusing to pay for advertising their time tables, the number of accidents upon them would increase correspondingly." It might be inferred from this that engineers and trainmen are in the habit of using time tables upon the road which they may happen to see printed in the daily papers, and that the absence of the time table of a road from the favorite newspaper of one of its engineers would leave him without any guide whatever in getting his train over the road. Railroad men will agree with us that it would be a very edifying sight to see an engineer of a passenger train with a copy of his evening paper, holding it up before the gauge lamp, trying to find out what time he was due at the next station, by a time table announcing simply that "the celebrated New York and Chicago Limited, the fastest and best train in America, composed exclusively of Wagner vestibuled parlor, sleeping, dining and smoking cars, lighted by electricity, etc., etc., leaves New York daily at 9 P. M."

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(310) J. B., Williamsport, Pa., asks: Will you please answer in the columns of your paper if there is any reward offered to the discovery of perpetual motion, or to any motor that would take the place of steam or electricity? *A.*—Not that we are aware of.

(311) J. C., St. Paul, Minn., writes: Will you kindly explain the meaning of inside lap on a steam engine slide valve, and state where measurements are taken from? *A.*—By inside lap is meant the amount that the inner edges of the valve, that is, the edges of the exhaust cavity, overlap the inner edges of the steam ports when the valve is in its central position. To measure the inside lap, subtract the distance between the inner edges of the valve from the distance between the inner edges of the steam ports, and divide the remainder by 2; the quotient will be the inside lap. This rule holds good only when the inside lap at one end is equal to that at the other end. When the inside lap is not equal, then determine the relative position of the valve at half stroke to that of the valve seat, and measure the inside lap from the inner edge of the valve to the inner edge of the steam port at the same end of cylinder.

(312) J. W. M., Jeffersonville, Ind., asks: Which is the best way to rebush the cylinder of a hydraulic car-wheel press? The present bush is made of copper, about ⅛ inch thick, 7½ inches inside diameter. I wish to reduce it to 7⅜ inches diameter, so as to obtain a greater thickness, as I intend to make the bushing of brass. Will brass be suitable? How should I proceed to put in the bushing so as to make it tight? *A.*—We see no objection to brass bushing. Turn the bushing accurately so that it can be driven in or pressed in with a screw press with a moderate force. 2. The gauge is made for a 7½-inch ram; what difference will it make using a ram 7⅜ inches diameter? *A.*—The area of a ram of 7½ inches diameter is 44.17 square inches; the area of a ram 7⅜ inches diameter, 42.71 square inches, making a difference of 44.17 − 42.71 = 1.46 square inches. This difference is 3.3 per cent. of the area of the ram 7½ inches diameter; consequently, the pressure of a ram 7⅜ inches diameter will be 3.3 per cent. less than with the 7½-inch ram. If your gauge indicates the total pressure on the ram (not the pressure per square inch) you will require a new gauge for the 7⅜-inch ram. 3. How do you find the width of a belt for driving machinery? *A.*—See table in answer to Question 510, in our issue of Nov. 24, 1888.

(313) H. H., Belton, Texas, asks: What is the horse-power of a 10x16 inches engine, number of revolutions, 150; boiler pressure, 80 pounds? *A.*—We should estimate it at 52 indicated horse-power. 2. How much water should be evaporated per hour for this engine? *A.*—That will depend on the design of the engine, as the following empirical rules—which are sometimes used—will show. For the best steam engines (those using high pressures and working expansively) the quantity of water required to be evaporated per hour per horse-power, is equal to the constant 150 divided by the square root of the pressure. The horse-power is to be understood as that given by the indicator. For good engines, divide a constant of 200 by the square root of the pressure. These rules have been established by Prof. R. H. Thurston. Ordinary slide valve engines often use steam with less economy than those referred to above; the point of cutting off is often at two-thirds of the stroke, which allows but one-third for expansion. For this class of engines we

may use a constant of 350; dividing this constant by the square root of the pressure will give the required amount of water to be evaporated per horse-power per hour. If, now, your engine belongs to the last class, we can estimate the amount of water required as follows: The square root of 80 pounds is 8.94+ say 9; and $\frac{350}{9} = 38.88$ pounds of water per horse-power per hour; hence, for 52 horse-power we will require $38.88 \times 52 = 2021.76$ pounds of water per hour. 3. What is the horse-power of a boiler 42 inches diameter, forty-six 3-inch flues, 12 feet long? *A.*—At 15 feet of heating surface per horse-power, we should estimate it at 34 horse-power.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

$100 Reward, page 14.

$100 Reward, page 14.

$100 Reward, page 14.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

25″ Upright Drills. J. E. Snyder, Worcester, Mass.

28″ Upright Drills. J. E. Snyder, Worcester, Mass.

32″ Upright Drills. J. E. Snyder, Worcester, Mass.

36″ Upright Drills. J. E. Snyder, Worcester, Mass.

Worcester (Mass.) Polytechnic Inst. See advt.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton & Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Best silk wiping towels for machinery in the market. S. A Smith, 23 S. Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

See S. W. Card & Co.'s (Mansfield, Mass.) Catalogue of Screw Plates for Gunsmiths and Amateurs.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See July 25, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

The hook on steam engines is being supplanted by the Dill disconnecting device made by the T. C. Dill Machine Company, 726 Girard ave., Phila., Pa.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by writing to The Hornell Iron Works, Hornellsville, N. Y.

Steam Boilers; Their management and working on land and sea. By Jas. Peattie Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties. Drawing and blanking done on short notice. Correspondence solicited. Punches, dies and special tools made when required. Edward S. Hotchkiss, Bridgeport, Conn.

For foundry or general manufacturing, a compact property in heart of Buffalo, N. Y. 98x380 ft., on two streets, near canal and R. R. Steam heated brick building ⅛ size of lot, four light, clear floors, two elevators, outside stairs, engine, boiler, main shafting, wagon scales, stables, abundant yard room. For sale cheap. Address M. H., 56 Pearl St., Buffalo.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Patterson, Gottfried & Hunter (Lim.), 146–150 Centre St., N. Y., carry a complete stock of Brush Copper, Celluvert Fibre, Oiled Paper, Hard Rubber, Rod & Sheet Brass, Brass, Copper & Iron Wire, Self-Hardening Tool Steel, Set & Cap Screws, Machine Bolts, Machine & Wood Screws, Taps & Dies, Files and Twist Drills, Blowers & Forges, Machinery, Tools & Hardware, Gear Wheels, Wood Pulleys, Shafting, Hangers & Belting. General factory supplies.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including July 18, 1889 issue, 81 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 96 articles have thus far appeared up to and including the July 25, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

W. P. Dugan will build a cotton gin at Bells, Tex.

W. E. Gamling will build a carriage factory at Marietta, Ga.

Smith & Hickman are enlarging their machine shop at Warren, Ark.

L. D. Dillon is interested in building engine and boiler works at Knoxville, Tenn.

The Salisbury (N. C.) Cotton Mills have increased their capital stock by $125,000.

An addition, 90x50 feet, is being made to the Adams Woolen Mill, at Philadelphia, Pa.

Williamson & Sons will rebuild their wood-working factory, recently burned at Asheville, N. C.

The Progress Manufacturing Co., Meridian, Miss., are building an addition 50x100 feet to their machine works.

The Sheffield (Ala.) Manufacturing Co. contemplate enlarging their wood-working factory and building a saw mill.

It is reported that the Stonewall Manufacturing Co., Stonewall, Miss., will put $25,000 worth of new machinery in their cotton mill at Enterprise.

The Tyler Steel Tube Company, Boston, Mass., has been awarded a contract for furnishing steel tubes to the Government for use in U. S. cruisers.

The Merrimac Spinning Company, of Lawrence, Mass., has been granted a charter of incorporation. Urlas Hardy, president; Richard Standing, treasurer.

The District Commissioners of Washington, D. C., will receive proposals until Nov. 1 for lighting the District by gas and electricity for one or five years.

A syndicate has been formed at Snohomish for the purpose of erecting a saw mill, with a capacity of 35,000 feet daily. It is expected to have it running by the first of September.

A pulp mill will be built at Sault Ste. Marie by the Soo Paper Co. It will have a capacity of twelve tons of pulp per day. The same company will build a paper mill to work up this product.

W. T., G. W. and J. K. P. Akers, and G. W. Stewart, have incorporated the Empire Milling Co., to operate a flour and corn mill at Marietta, Ga. The capital stock is $80,000.

The machine shops of the Northeastern Railroad, at Meridian, Miss., are to be enlarged by the erection of a two-story brick building, to contain machinery for car building and a paint shop.

Robert MacKinnon contemplates moving his knitting mill from Little Falls, N. Y., to Fonda or Frankfort. It is said that the Frankfort citizens will subscribe not less than $25,000 to build a mill.

H. W. Johns Manufacturing Company, 87 Maiden Lane, N. Y., issue a descriptive price list of their specialties, consisting of nearly everything into which asbestos enters, as well as other specialties.

A stock company will be organized by E. B. Curtis, E. E. Sell, of Aiken, and others, to build a cotton mill on Shaw's Creek, Montmorenci, S. C. Capacity will be from 2,500 to 4,000 spindles. Water power will be used.

A 2,000 spindle cotton mill is to be erected in the city of Bessemer, Ala. Ten years ago that place did not have 500 population. Jonesboro, Ga., ten years ago an insignificant hamlet, is building a 10,000 spindle cotton factory.

Millard Adler, of New York, has leased from J. M. Quarles and others, of Nashville, the mineral paint mines near La Vergne, and will erect machinery to cost $20,000 for excavating and preparing the mineral paint for shipment.

The Concord Gas Light Company, of Concord, N. H., which recently purchased the electric light plant in that city, has increased its capital stock from $100,000 to $150,000. The par value of the stock is $50, and the new shares are selling at $80 each.

The National Iron and Brass Works, of Dubuque, Iowa, have the contract to furnish a Smedley duplex pump for the power house of the Cable Company, at Sioux City. They also have the contract for entire water-works plant at St. Clara's Academy, Sinsinawa Mound, Wis.

Blodgett & Osgood, of St. Paul, the manufacturers of ready-made houses, are getting out material for two fine summer residences to go to Cape May, N. J. Their ready-made houses are in great demand all over the country tributary to St. Paul, and in remote southwestern points.

A glass company lately organized at Tarentum, Pa., with a capital of $50,000, has accepted an offer of thirty-five acres of ground from citizens of Blairsville, and will locate their works there. The company will employ 300 men, and promise to finish their plant in six months.

The Chicago and Cicero Water, Light and Power Company, of Morton Park, Ill., capital stock, $50,000, has been granted a license to furnish water, light and power for domestic and manufacturing purposes. Incorporators, Frank Sayre Osborne, M.H. Burgett and Henry R. Pebbles.

The Hoppes Mfg. Co., Springfield, Ohio, have sold during the month of July, about 4,000 horse-power capacity of their live steam water heater and purifier. We are informed that business in this heater is showing a healthy increase. The company publish a catalogue that is of interest to engineers.

The Chicago and Calumet Rolling Mill Company, with headquarters at Chicago, was incorporated last week with a capital stock of $1,000,000. The incorporators are Jean L. Pfau, J. Louis Pfau and George Campbell. It is understood that the company will erect a large rolling mill at Calumet, and make steel rails.

After two months' idleness, during which the plant of the United States Iron & Tin Plate Company, Pittsburgh, Pa., was repaired and enlarged, two-thirds of the works have been, and the remainder will be shortly put in operation, at which time the big new forty-four inch plate mill, which is being completed, will be put in operation also.

David Gibson, of Chattanooga, Tenn., has purchased the Ashtabula Plow Handle Works, of Ashtabula, Ohio, and will at once move them to Chattanooga. This is a new industry in the South, and one that it is believed will prove as successful as the plow business has been. It is believed that the works will be in full operation this fall, and will employ a large force of hands.

The Jackson (Ill.) National Gas Light and Fuel Company, which was located two years ago to make water gas, and which is composed of Chicago capital, recently purchased the old coal gas plant, paying $65,000 cash. The former company now controls all the gas in Jackson, and will enlarge the works, reduce coal gas to $1.00 per 1,000 feet, and water gas to twenty-five cents.

The Nashville Furnace Company has been organized at Nashville, Tenn., and has acquired the title to the two furnaces erected in West Nashville. The new company are making arrangements for the supply of ore and coke and limestone, and will start up one of the furnaces as soon as a sufficient supply of materials has been collected. The second furnace will be fired soon after.

There is water-works agitation at Portland, Ore.; Woodstown, N. J.; Germantown, Pa.; Amityville, N. Y.; Nevada City, Cal.; Chattanooga, Tenn.; Philadelphia, Pa.; West Knoxville, Tenn.; Tekamah, Neb.; Waterloo, Ind.; Waterbury, Conn.; Missouri Valley, Iowa; Sheffield, Ala.; Lexington, Ga.; Bowling Green, Ky.; Cambridge, Md.; Beloxi, Miss.; Bonham, Texas; Cuero, Texas.

A paper mill is being built at West Dedham, N. Y., on the Black River, which will be one of the largest in the country. The establishment will cover three acres, and have a capacity of turning out sixteen tons of paper a day. A large pulp mill will be connected with it, and, as the concern is backed by a strong company, it is expected that the work will be rapidly advanced, and that everything will be completed the coming fall.

The Kilbourne & Jacobs Manufacturing Co., of Columbus, O., have just issued a general catalogue, illustrating the most complete line of earth-handling implements for contractors, and wood and metal wheelbarrows now made in this country, and also showing several articles recently added to their various and extensive former lines. They also issue a special catalogue, showing the store and railroad trucks, depot baggage and express wagons, etc., made by them.

The Central Nail Company, of Wheeling, W. Va., with a capital stock of $1,000,000, has been chartered by the Secretary of State. The incorporators are A. W. Campbell, S. K. Walkie, Joseph Bell, W. L. Glessner and I. N. Vance, all of Wheeling. The object and purpose of this company is believed to be the handling of all the nails manufactured by the mills in the Wheeling district and the West, as the incorporators represent different mills immediately around and in Wheeling.

The Mining and Scientific Press, of San Francisco, says: Car building is becoming an important industry in Stockton. Orders are received from all parts of the Pacific coast. The work of the present summer embraces orders from Portland, Spokane Falls, Sacramento, Fresno, etc. The business is carried on at the Combined Harvester & Agricultural Works, under the immediate charge of S. W. Elliott. The style of wood turned out is of superior kind. There is no need that our railroad builders should go east for their cars.

It is reported that the Brice-Thomas syndicates will build an extension of the Santa Fe Railroad south from Santa Fe for a distance of about twenty-five miles, which will penetrate a region wonderfully rich in gold, silver, copper and lead deposits, inexhaustible placer fields, and large areas of anthracite and bituminous coals. It will bring that city within an hour's ride of three booming mining districts, and, consequently, there is much rejoicing here over the very flattering prospects for completing the extension this year.

A special to the *World*, from Charleston, S. C., says that an application for a charter for the Charleston Cotton Oil Refinery has been made. The capital stock is to be $200,000, and the originators have already secured a site on the water front and the promise of all the money needed. An opportunity, however, will be afforded all the independent cotton seed oil mills in the State to subscribe and become interested in the enterprise. The company grew out of the needs of the oil mills in the State outside of those controlled by the Standard Oil Trust for a refinery.

Nicholson & Waterman, Providence, R. I., have issued a very neat catalogue of machinery and tools made by them. This firm has been gradually increasing their field of operation, until their catalogue shows a fine assortment of threading and tapping machines, facing machines, broaching machines, drilling and countersinking machines, cutting off machines—in fact, an excellent assortment of machine shop tools, including lathes up to 54-inch swing, and special tools for locomotive and car works, and for special machine shop work. The catalogue is of convenient size, and should be in the hands of manufacturers and engineers.

Gould & Eberhardt, Newark, N. J., have received the following from an industrial firm in Mexico: "Please find enclosed draft for $74.50, $72 of which is in full payment of your bill for shafting turning attachment; the other $2.50 I wish you would do me the kindness to deliver to the office of the AMERICAN MACHINIST, to pay for the subscription for this year. In regard to the drill that we bought from you, I will say it is the best tool of the kind that I ever saw, and it would be impossible to be pleased better; in ordering tools in the future, I shall first consult with you, and if you make your other tools anything like this drill, I shall be one of your customers."

An American company is just opening extensive iron mines in the Cuban mountains. The company includes some of the Minnesota men, who made the Vermillion district famous, as well as owners in the East. The territory is about 20 miles west of Santiago, near the coast, and in the Dalquiria Mountains. Capt Elisha Norcom, of Tower City, Minn., who has just visited the property, says that "this is the ore region." The territory purchased by the company will, when opened, be the second mine in operation in the country. The other is worked by the Pennsylvania and Bessemer Steel Company. It was a question how to get the ore to the seaboard. It could only be by a railway to Santiago, 20 miles, or by one directly to the coast, 3½ miles. The latter meant the construction of a harbor and breakwater, but the company decided on it, because, although it would cost more, it would be more economically maintained. The construction of the harbor has been begun. The ore is said to be 64 to 68 per cent. metallic iron, and will be sent to this country.

The Panhandle Machinery and Improvement Company of this city is fast making Fort Worth the pump and windmill center of Texas. The best ranchmen in the State attest to the superior qualities of their U. S. Solid Wheel Windmill. They carry in their warehouse and salesrooms, corner Throckmorton and First streets, the largest and most complete stock of windmills, steam pumps, pump and well supplies to be found in the South. Mr. W. S. Marshall, the president of this company, has had twenty-five years' experience as a hydraulic engineer, and has planned and erected the most complete ranch water supplies in the State. All work done by this company is guaranteed. They have in course of erection, in different parts of the State, windmills varying in size from 12 to 30 feet diameter. Any one in Texas needing a complete and satisfactory water supply will serve their best interests by corresponding with this Fort Worth company. Committees are at work for a stove foundry, a woolen mill, and a canning factory. The Fort Worth cracker factory will be running in a few days. The Fort Worth jute bagging factory will be in full operation inside of a week or ten days, is even now making jute bagging; the only Spanish moss collar factory in the United States is nearly ready for business; the Fort Worth Iron Works are now working eighty-five men, and with the cotton mill added to this list, the foundation for a city of factories will have been laid.—*The Gazette*, Fort Worth, Texas.

A Johnstown (Pa.) dispatch says: A plan which the Cambria Iron Company is contemplating for making available building sites, suitable for cheap homes for workmen, has been made public. This company owns a large farming tract of land on Yoder Hill, just west of town. The top of this hill is about 1,781 feet above the level of the sea, while the Pennsylvania Railroad station is only 1,184 feet. It will thus be seen that one danger—that of floods—can never trouble this place. It is proposed to build an inclined plane from near the center of the town, which will reach the location of the new lots in a little more than half a mile. Here probably 500 acres can be laid out in pleasant building lots, from where access to the mills will be easy. These it is proposed to have promptly laid out to the best advantage by Charles R. Miller, one of the most noted civil engineers in the country, who laid out the town of Bryn Mawr. A general and complete plan of the whole tract will be made, and upon a section of it streets and alleys will be promptly graded and paved or macadamized, and other sections opened as required. Water and illuminating gas mains will be laid in connection with the general systems of this city. The natural gas main already runs through the property. An efficient sewerage system will also be introduced. The deeds will contain stringent provisions prohibiting the sale of liquors, as it is proposed to make this a place of homes. Provision will be made for locations of religious and educational buildings. A site will also be reserved for a large hotel. The scheme is looked upon with much favor, and will help to solve the problem of the future of Johnstown.

Machinists' Supplies and Iron.

NEW YORK, Aug. 10, 1889.

Iron—American Pig.—The market continues in a satisfactory condition, judging from the producer's point of view, but the fresh business has been confined to the requirements of small consumers, who do not buy in large quantities. There has been no change in values which is quotable. We quote, Standard Northern brands, No. 1 X Foundry, $17 to $18; No. 2, $16 to $16.50. Southern brands, No. 1, $16.50 to $17; No. 2, $15.50 to $16; Grey Forge, $14.50 to $15.25.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Position wanted in Chicago by a machine shop superintendent. Address BOX 9, AM. MACHINIST.

Mech. draftsman, with six years' shop experience, wants position. Address N. T., AM. MACHINIST.

Foundry foreman, 25 years' exp. on gen'l mach'y & locomotive work, wants position. Iron, AM. MACH.

An experienced mechanical draftsman wants a position. Address BOX 11, AMERICAN MACHINIST.

Mech. draftsman wants position; 3 y'rs machinist, 5 y'rs pat'n maker, 7 y'rs draftsman. Jack, AM. MACH.

Wanted.—A foundry foreman in small foundry; must be familiar with modern methods and heavy work. Address BOX 13, AMERICAN MACHINIST.

Situation wanted, by first-class pattern maker, age 40; 25 years' exp.; distance from New York no object if fare allowed. Pattern Maker, AM. MACH.

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Wanted—First-class machinists. None others need apply. Wages $2.25 per day of 10 hours, with chance for advancement if found worthy. The Pond Machine Tool Co., Plainfield, N. J.

Mechanical engineer and draftsman wants situation; 2 years' engineering college; 9 years' prac. exp. marine, hydraulic and general engineering work; good references. A. N. B., AMERICAN MACHINIST.

Wanted—A foreman for a small machine shop; must be a good mechanic with push and energy; state age and experience; also give reference. Address BOX 12, care AMERICAN MACHINIST.

Wanted—Immediately, two or three good general machinists for lathe and floor work; good wages and steady situation for suitable men. Apply or address to Kenney & Co., Scottdale, Pa.

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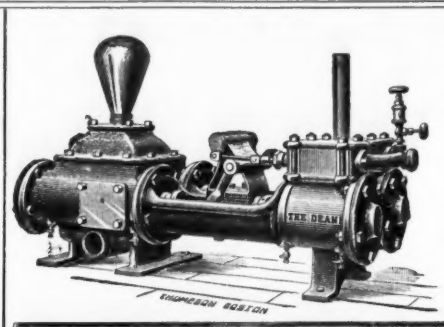

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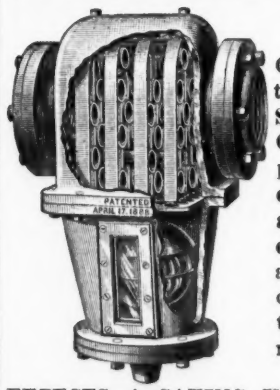

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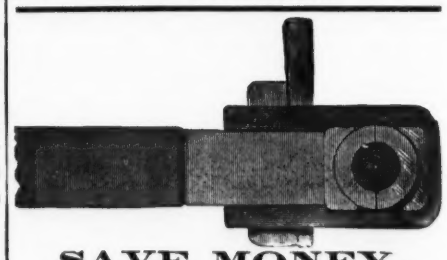
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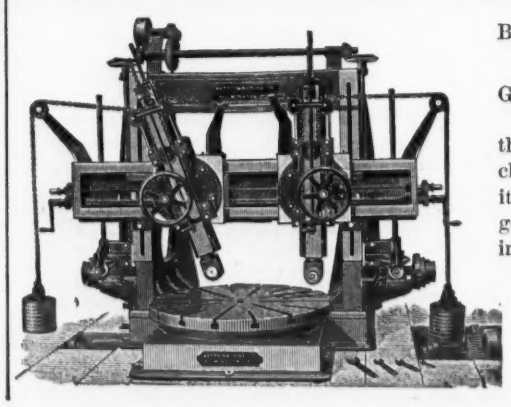

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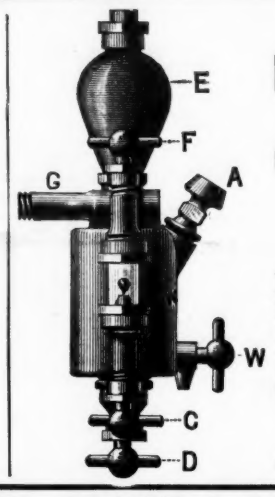

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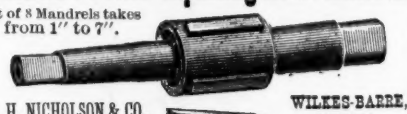

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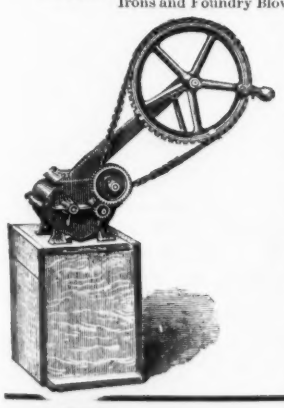

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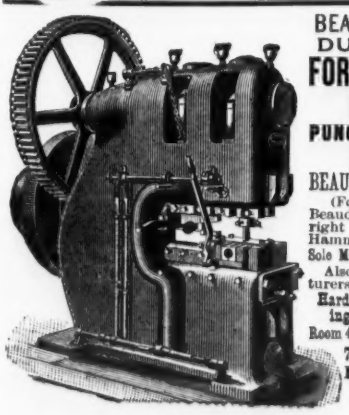

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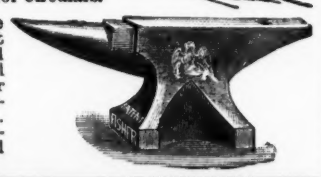

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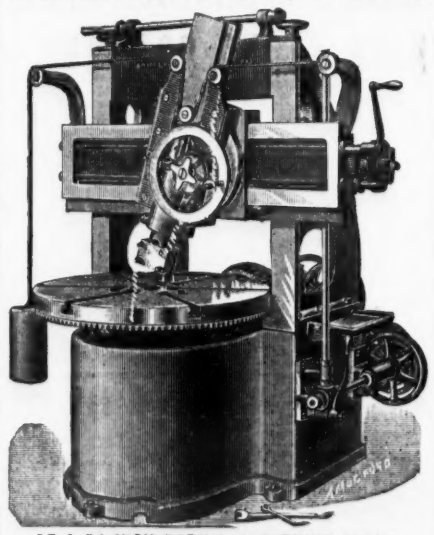

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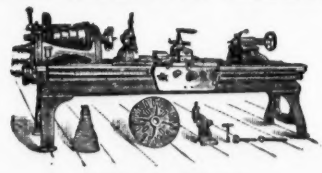

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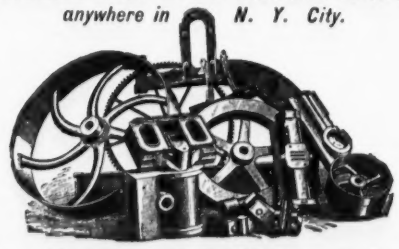

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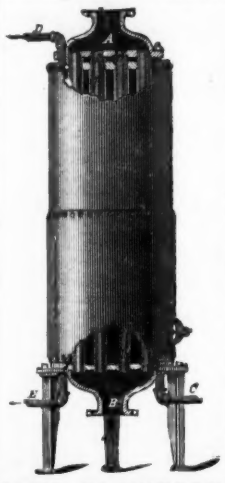

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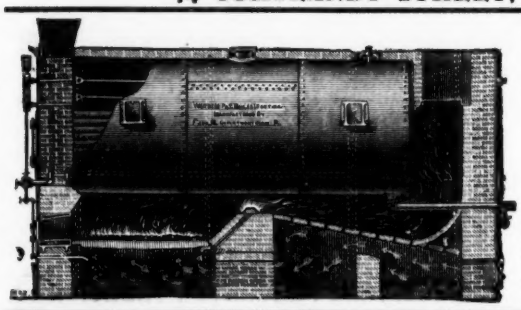

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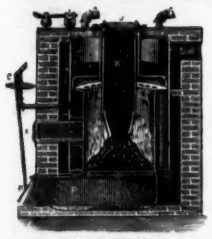

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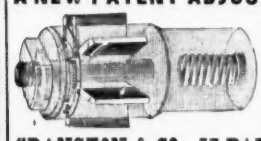

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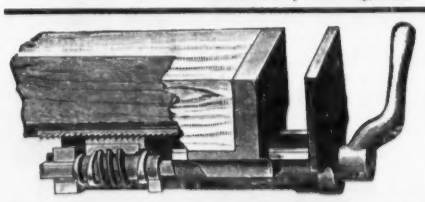

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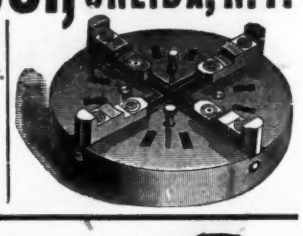

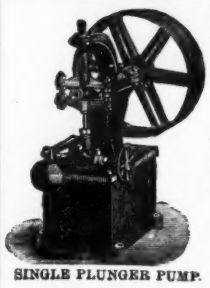

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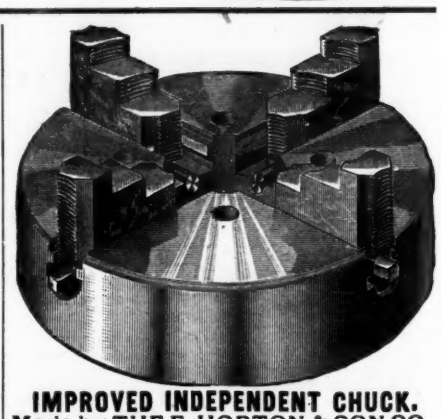

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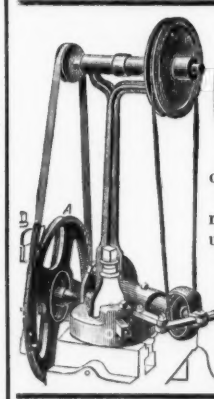

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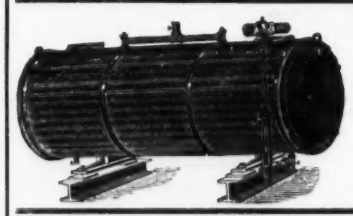

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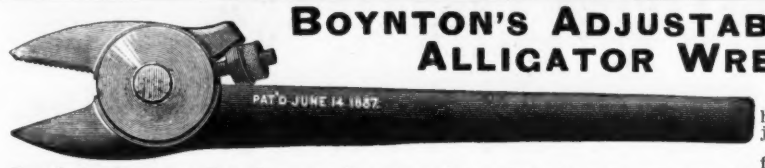

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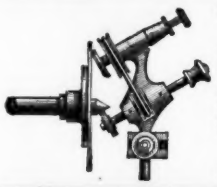

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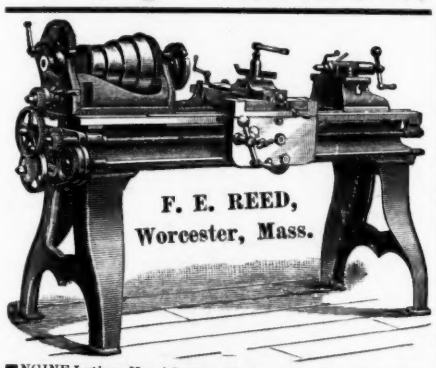

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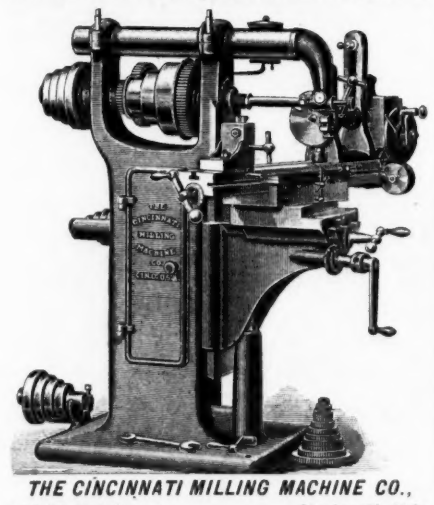

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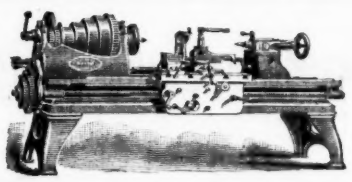

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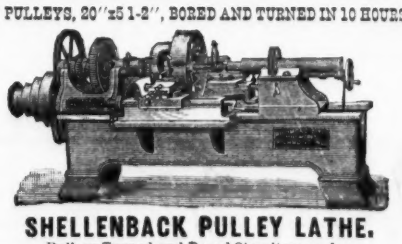

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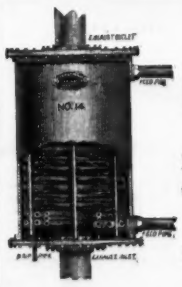

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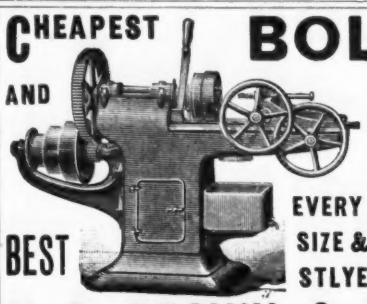

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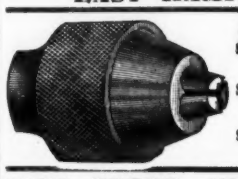

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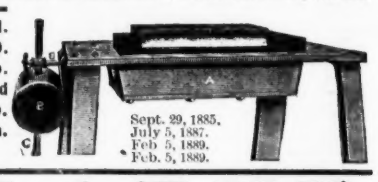

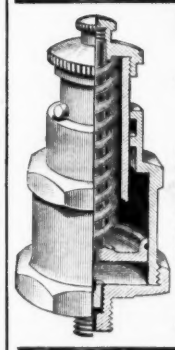

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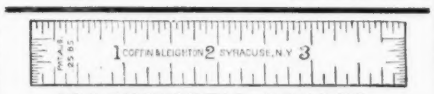

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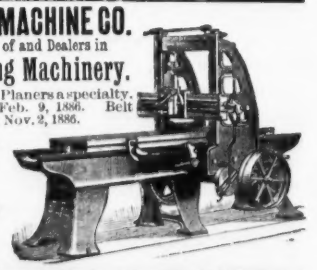

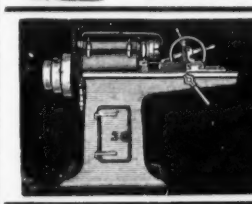

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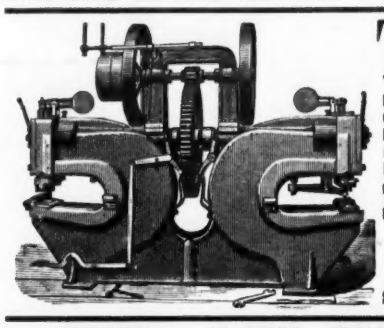

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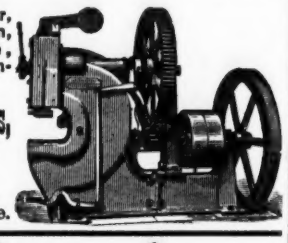

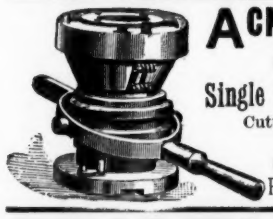

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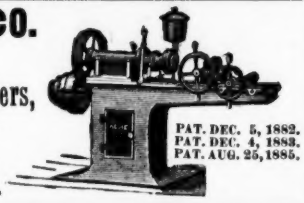

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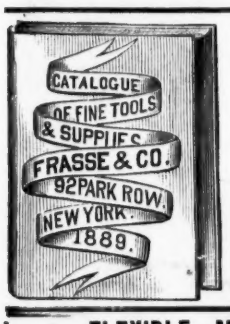

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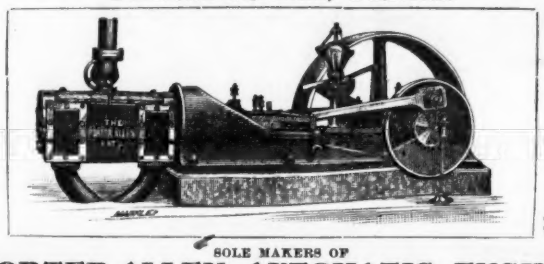

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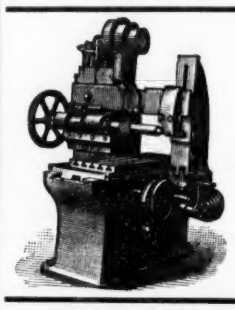

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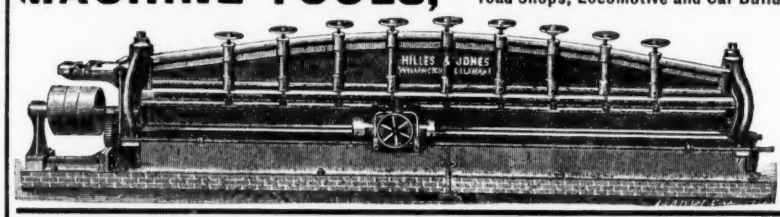

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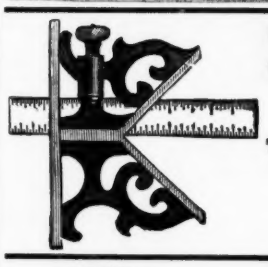

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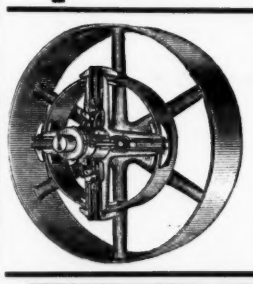

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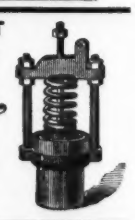

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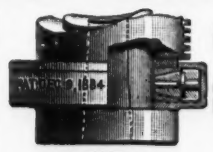

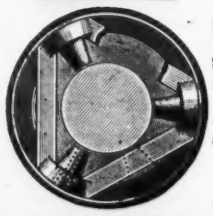

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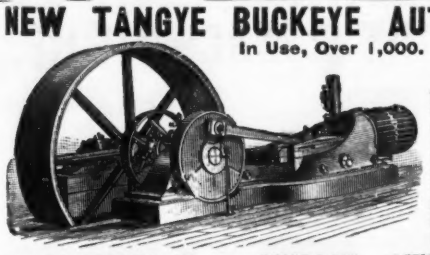

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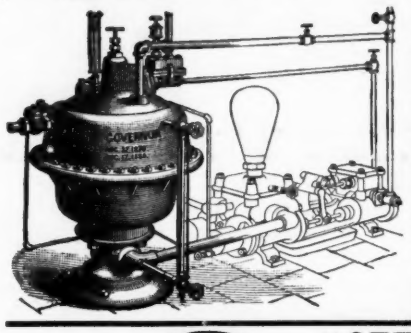

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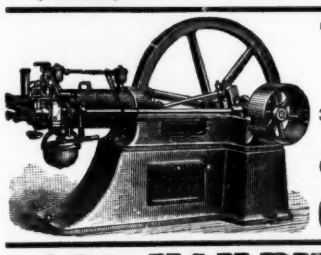

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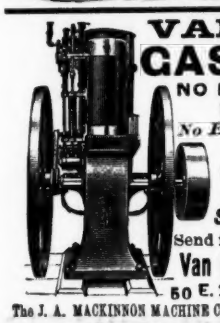

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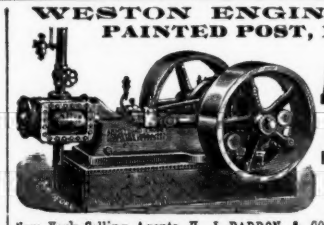

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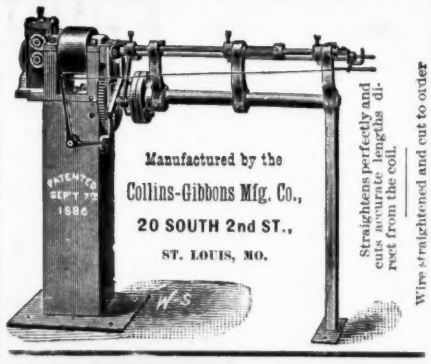

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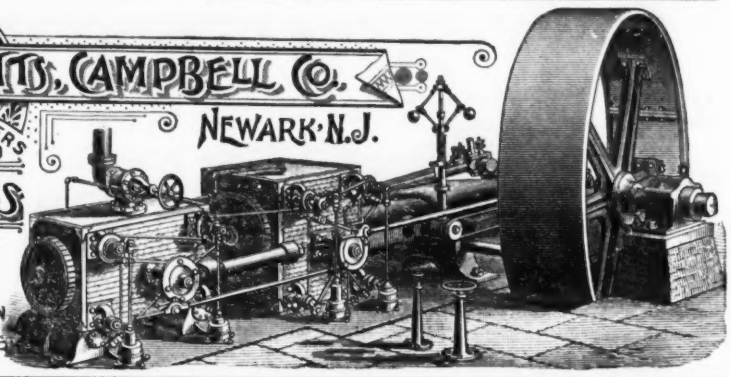

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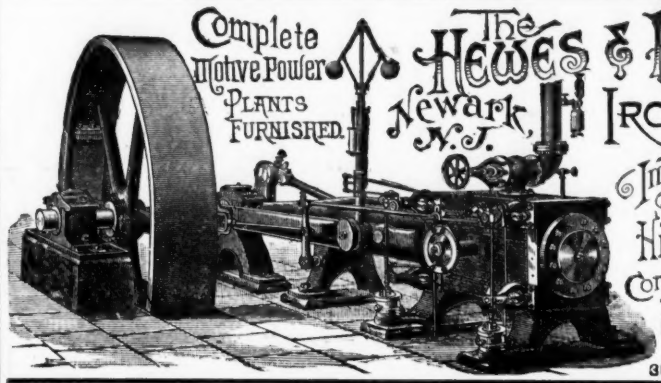

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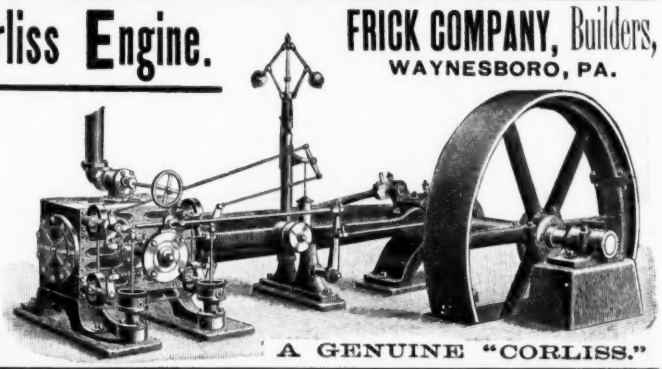

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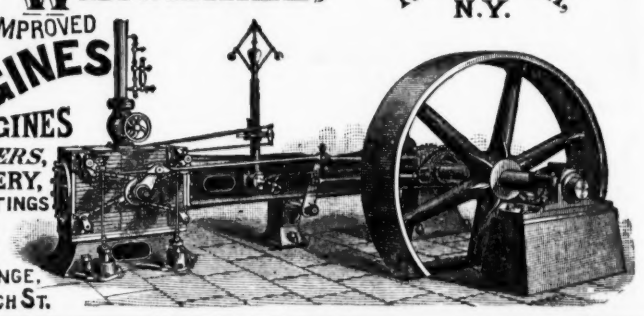

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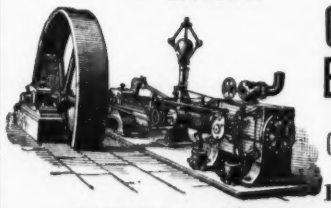

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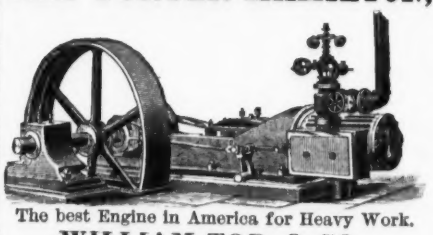

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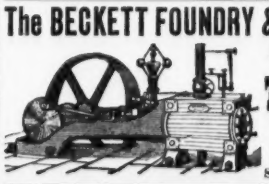

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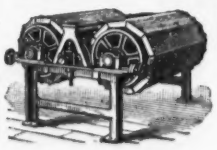

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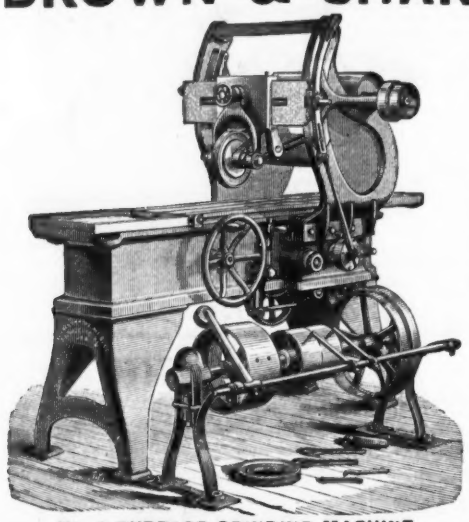

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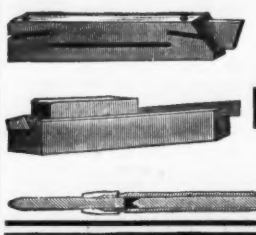

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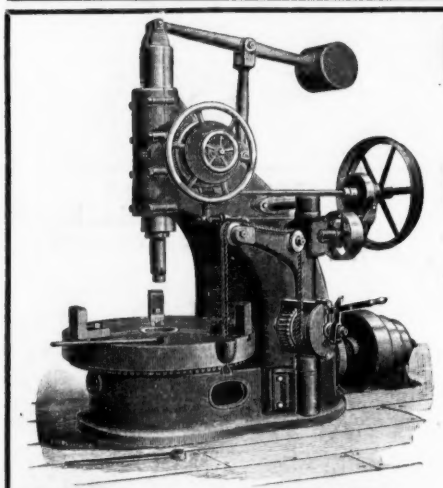

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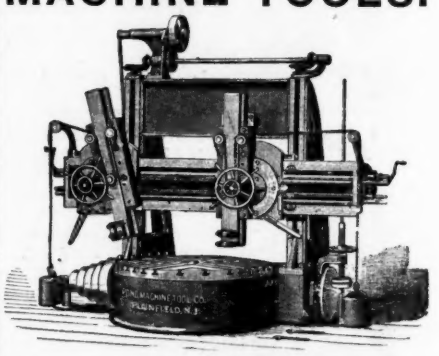

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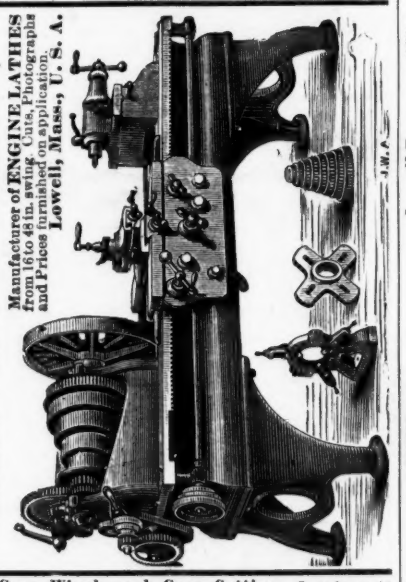

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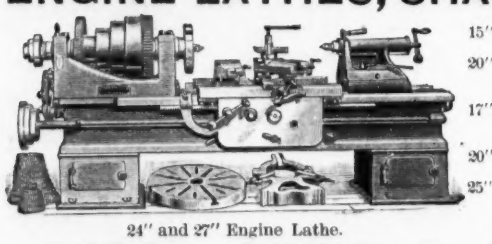

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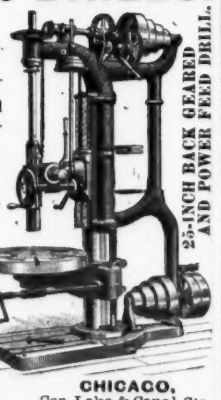

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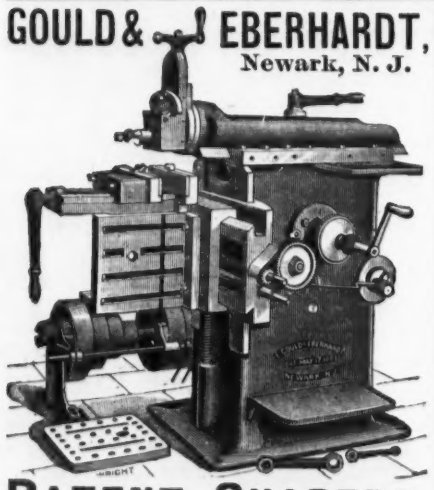

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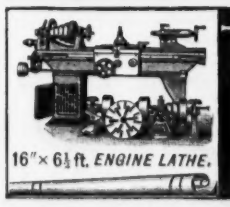

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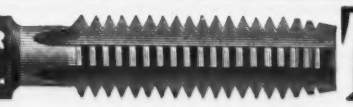

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